Technical Report 847

The Application of Computers to Learning in the Command and General Staff College: Identification of Computer Opportunities

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Cognitive Engineering and Design Research Team

June 1989

United States Army Research Institute for the Behavioral and Social Sciences

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A front-end analysis was conducted regarding the expansion of the use of computers in instruction at the U.S. Army Command and General Staff College (CGSC). Instruction at the CGSC is aimed principally at small groups of students. The underlying teaching philosophy emphasizes the students' responsibility to apply in classroom interactions, concepts, and procedures learned earlier in individual study. This instructional strategy readily lends itself to applications of computers to learning (ACL) from each of the categories used by the project team. However, introduction of many computer applications into college classrooms would need to take place over a period of years, depending upon how quickly the needed computers can be acquired and the appropriate software written. This report suggests appropriate ACL for each subcourse of selected courses taught at the CGSC and how much of each subcourse might eventually be taught by using those applications.

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19. ABSTRACT (Continued)

This report presents the findings and recommendations of Task G of the Front-end Analysis. Other reports are separately bound. The reports all have the beginning title, The Application of Computers to Learning in the Command and General Staff College. The follow-on headings for the reports are as follows:

A Front-End Analysis Study
CGSC Analysis
Analysis of Staff Officer Knowledge, Skills, and Abilities
Assessment of Computers in Education at Various Institutions
Technology Assessment
Assessment of Computer Literacy in CGSC
Analysis of Institutional and Financial Constraints
Army Command and Control Concepts Study
Comparison of Knowledge, Skills, and Abilities to CGSC Learning Objectives

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Human Factors in Training
and Operational Effectiveness

FOREWORD

The Command and General Staff College (CGSC) trains officers to act as coordinating staff members and to assume command positions at Brigade and higher echelons. The Deputy Commandant of CGSC requested a front-end analysis to determine how emerging technology could be used at CGSC to close the gap between the classroom and "real" experience. The talents of the Cognitive Engineering Design and Research Team (CEDAR) of the Los Alamos National Laboratory were elicited for performing the analysis, in cooperation with the Fort Leavenworth Field Unit of the Army Research Institute for the Behavioral and Social Sciences (ARI). The results of the study marked a major milestone in defining requirements for the implementation of instructional technology in the Army's key training arena for tactical command and control operations. The portion of the overall study documented in this report involved the matching of computer technological opportunities to training objectives.

This effort was supported under ARI research task 144, Advanced Technology for Command and Staff Operations. The work was performed under the long-standing memorandum of understanding between ARI and CGSC entitled, Research and Evaluation program for Present and Future Command and Control Requirements and Operations, 31 May 1983. On 24 November 1986 MG Frederick M. Franks, then Deputy Commandant, requested assistance for this project by letter and on 15 December 1986, Dr. Stanley M. Halpin, Chief, Ft. Leavenworth Field Unit, responded affirmatively by return letter. Status briefings were provided to the CGSC throughout the project with final briefings presented to the Assistant Deputy Commandant and CGSC Directors on 14 August 1987 and to MG Gordon R. Sullivan, Deputy Commandant, on 13 November 1987. The effort has been accepted and endorsed enthusiastically by CGSC and, as a result, implementation planning is taking place.

EDGAR M. JOHNSON
Technical Director

PREFACE

This report concerns one of the Army's most important institutions, the United States Army Command and General Staff College (CGSC), which is the font of tactical and operational knowledge for Army forces. This knowledge is a major force multiplier that holds potential enemies at bay, enhances deterrence, and thus moves us closer to a lasting peace.

The CGSC is a complex organization that is undergoing a major change brought about by computer technology. Further, the pace and scope of the change is faster and broader than in the past. The Army, educational technology, and tactical doctrine are changing concurrently. CGSC must not only keep up, but must also assist in the process because the College is an instrument of change for the Army. CGSC is the leader of the other Training and Doctrine Command (TRADOC) schools and centers, which directly affect almost every field grade officer in the Army. Finally, the College prescribes how the Army will fight and how its staffs will function.

This view of the CGSC was held by the Los Alamos project team and suggests that the actions to be initiated, based upon this report, are far reaching because they will influence the quality of our Army in the years to come. The study was conducted in this spirit.

The following people, listed alphabetically, contributed to this front-end analysis study:

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THE APPLICATION OF COMPUTERS TO LEARNING IN THE COMMAND AND GENERAL STAFF COLLEGE: IDENTIFICATION OF COMPUTER OPPORTUNITIES

EXECUTIVE SUMMARY

Requirement:

This study was conducted to determine how best to introduce computers into the Command and General Staff College (CGSC) curricula. This report documents Task G of the study, which identifies the expanded use of computers to achieve instructional objectives at CGSC.

Procedure:

Information was combined from the study's Task A (CGSC Curricula Analysis), Task B (Analysis of Staff Officer Knowledge, Skills, and Abilities), and Task F (Comparison of Knowledge, Skills, and Abilities to CGSC Learning Objectives). Courses of the resident phase of the Combined Arms and Services Staff School (CAS^3), of the curriculum of the Command and General Staff Officers Course (CGSOC), and of the School of Advanced Military Studies (SAMS) were examined to determine how computer technologies could be applied. Conceptual categories were developed to classify applications of computers to learning (ACL). For each subcourse, estimates were made of the proportion of classroom hours that might be taught by each ACL category. A summary analysis of potential, risks, and costs was made for each of the ACL categories and an action was recommended.

Findings:

The analysis suggested that all CGSC instruction would benefit from using computers for administrative tasks associated with instruction because of increases in the productivity of the staff and faculty. It was estimated that 55% of resident classroom instruction would be appropriate for ACL, with an expected improvement due to ACL. The realization of the ideal use of ACL will require many prerequisite actions in terms of acquisition planning and courseware and software development.

Utilization of Findings:

This front-end analysis will be used to guide implementation of a program to expand the use of computers in CGSC instruction. The findings identify the initial steps to be taken in the implementation and describe the actions that should be taken for a long term payoff in ACL. This phase of the analysis identifies appropriate opportunities for the use of computers in the CGSC curricula.

THE APPLICATION OF COMPUTERS TO LEARNING IN THE COMMAND AND GENERAL STAFF COLLEGE: IDENTIFICATION OF COMPUTER OPPORTUNITIES

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THE APPLICATION OF COMPUTERS TO LEARNING IN THE COMMAND AND GENERAL STAFF COLLEGE: IDENTIFICATION OF COMPUTER OPPORTUNITIES

INTRODUCTION

In completing this task, the project team used the information gathered in doing Task A (CGSC Analysis), Task B (Analysis of Staff Officer Knowledge, Skills, and Abilities), and Task F (Comparison of Knowledge, Skills, and Abilities to CGSC Learning Objectives) to provide suggested methods of achieving training objectives through the expanded use of computers in instruction at the Command and General Staff College (CGSC). The results constitute the considered judgment of the project team based on its own experience; however, applying computers to learning, which is both an art and a science, is generally in its infancy. In particular, conceptual categories to classify applications of computers to learning (ACL) were devised by the project team in the absence of existing experience with some of the applications in contexts like that at CGSC.

With regard to the specific material taught in the various schools of CGSC, the use of computer simulations both for individual and collective training, for example, will have to await the development of suitable models and their conversion to programs in forms that are appropriate for the kinds of computers that will be available to the instructors and students.

The history of combat simulation modeling for use with computers principally reflects preoccupation with the weapons acquisition process or other concerns of the analytic community that has developed or used the models rather than with teaching combined arms doctrine and staff operations either in the classroom or in the Army in the field. Clearly, models designed for one function will not necessarily adequately serve the purposes of the others.

Similarly, intelligent tutoring systems (ITS) for use at CGSC are today purely notional and will remain so until they are actually designed, which, as with simulations, will be a difficult, time consuming, and possibly expensive task with benefits that will have to be weighed against these factors. The same will be true to a lesser degree for the other categories of ACL. The development of appropriate courseware may be the greatest obstacle to be overcome in expanding the use of computers in CGSC classrooms.

In the meantime, instruction given to small groups of students is the preferred instructional strategy at CGSC and appears to maximize opportunities to apply computers in CGSC curricula and will presumably be more widely implemented as new facilities are made available to the schools of the College. ACL will not supplant the role of the instructor in staff group instruction, whose efficacy depends in large part on success in stimulating and guiding mutually enlightening interactions among the students toward the end of honing the problem solving skills they will need throughout their careers. The role of the computer in and out of the classroom is to enhance the ability of the instructor to play his role effectively by easing his administrative tasks, by affording an efficient means of conveying information, and by offering the possibility of easily portraying a wide variety of situations with which to challenge the students' mastery of curriculum material.

TASK DESCRIPTION

Goal

The goal of Task G was to identify specific opportunities to apply computers to the learning process at CGSC and to suggest specific methods of exploiting those opportunities in a preferred instructional strategy for imparting the knowledge, skills, and abilities (KSA) students are expected to acquire at the College.

Relationship of Task G to the Total Project

In completing Task G, the project team drew from the results of Tasks A, B, and F to serve the goals of the project. Task G contributes to reaching those goals by describing a level of use of computers at CGSC that represents the final stages of the acquisition and deployment of hardware and the development of suitable software. This level of use could be attained only after a number of years determined by the rate that would be achieved in the deployment and development, which will be subject to the constraints identified in the Task D report entitled Analysis of Institutional and Financial Constraints.

Assumption

ACL at CGSC from each category defined by the project team in this report will be developed in the next few years and will represent significant improvements in teaching methods applied in accordance with a preferred instructional strategy.

METHODOLOGY

Subcourse Examination

The project team examined each subcourse of the resident phase of the course taught by the Combined Arms and Services Staff School (CAS^3), of the core curriculum and electives of the Command and General Staff Officers Course (CGSOC), and of the course taught by the School of Advanced Military Studies (SAMS) for the purposes of determining which categories of ACL would be suitable for achieving at least some of the subcourse learning objectives. The examination also resulted in estimates of the proportion of the number of subcourse classroom hours that might be devoted to ACL of each category after the appropriate courseware had been designed and implemented. Part of the examination dealt with assessing alternative instructional strategies for their applicability to computer-based training at CGSC.

Products of the Examination

The judgments resulting from the examination of the subcourses are the suggestions of the project team for aiming effort at CGSC toward the eventual goal of achieving the best use of computers in its instruction.

ANALYSIS OF ACL ELEMENTS

This section provides the project team's judgments concerning how computers could be applied to learning in the CGSC. These judgments describe how the ACL taxonomy that was developed by the project team can be applied to the College. Because the discipline of computers in education is still in its infancy, the ACL taxonomy is a viewpoint from a 1987 perspective and will necessarily evolve over time. This information represents an ideal world of the future that will expand as the ideal develops.

The project team examined the CAS^3 Phase II, CGSOC core curriculum, CGSOC electives, and SAMS for opportunities for computer usage. These courses make up the bulk of the relevant opportunities for computer usage in the College.

Upon examining the curricula listed above, the project team found that the CGSOC electives were different from the others in a fundamental way. In academic year 1987-1988, the electives comprise some 3,120 hours of subcourses ranging in length from 15 to 90 hours. If included, these 3,120 hours would heavily influence the results. Each student normally takes 210 hours of electives. Some electives are not taught because sufficient numbers of students do not enroll. For these reasons, the project team felt that the electives analysis was distinct and separable from the other analyses in the final tabulations.

The original data for this analysis were those in the POI (program of instruction) and catalog provided by the College. CAS^3 and SAMS data were based on POI current for academic year 1986-1987. Little, if any, change was anticipated in the curricula of these courses for academic year 1987-1988. Late in the study, however, the project team obtained the CGSC Catalog for Academic Year 1987-1988 (CGSC Circular 351-1, May 1987). Substantial change was noted in the curricula for the CGSC core and elective subcourses. The project team chose to use these current curricula for opportunities for the ACL because they would be more beneficial to the College.

To analyze the potential ACL, the project team used the taxonomy for the ACL developed earlier in the study. As developed, the taxonomy consists of the following elements:

- Administration
- Testing
- Computer-Assisted Instruction (CAI)
- Simulation for Individual Training (SIT)
- Intelligent Tutoring Systems (ITS)
- Gaming
- Simulation for Collective Training (SCT)

The taxonomy was modified by adding another entry "NA" for no application other than administration. The project team emphasizes that a taxonomy attempting to describe all possible categories of ACL has not been published before and that this taxonomy is conceptual in nature. By this expression, the project team means that many of the application ideas described in the taxonomy do not exist, and some have not been attempted. For example, no game exists that could be applied to the educational environment at the College, and it is probable that none will exist in the next few years.

The analysis was conducted by estimating the percentage of the hours of each subcourse for each computer application in the modified taxonomy. The NA entry was created to be able to account for 100% of each subcourse. The tables that follow show the project team's estimates for the number of hours in which ACL could be used for all subcourses for CAS^3 Course Phase II, CGSOC Core Courses, CGSOC Electives, and SAMS. The comment column shows, in short form, ideas for how ACL could apply in each subcourse.

Description of ACL Elements

The results of this analysis consist of a detailed description of each of the elements of ACL. Included in these detailed descriptions are Tables I through V, which show the project team's assessment of where each ACL could be applied in subcourses throughout the College. The ACL taxonomy that was developed by the project team is applied to the curricula of the CGSC in these tables. A table is presented for the CAS^3 Phase II resident course, for the core curriculum of CGSOC, for the electives of CGSOC, and for the SAMS course. Each curriculum is broken down into its subcourses as organized by the latest POI given to the Los Alamos project team.

The information recorded in the columns of the tables includes the number of hours in the subcourses, the percentages of the subcourses for which the various categories of ACL could be applied, and comments. At the bottom of each table a summation line and a percent line are included. The summation line indicates the project team's assessment of the number of course hours to which the relevant ACL could be applied. Table V shows two summations, one for total hours and percentages for each of the ACL elements for all four courses examined here and the other for the totals without the CGSOC electives included.

Networking

Before considering the individual ACL elements, a discussion of the impact of networking on the College is in order. In many ways, networking is a part of the administration element of ACL, but it transcends administration because other elements of the taxonomy depend on networking.

An analysis of the relationships among the faculty, students, facilities, and organizations was performed. Figure 1 shows the layout for the following functional requirements for networking in the College:

- Faculty access to information and databases for both instruction and doctrine development.
- Faculty communication with other faculty members and individuals at other service schools, including electronic mail, asynchronous conferencing, and data transfer.
- Faculty-student communication for exchange of homework and for discussion of instructional material, including asynchronous communication.
- Faculty, staff, and student administrative support.
- Student access to information and databases.

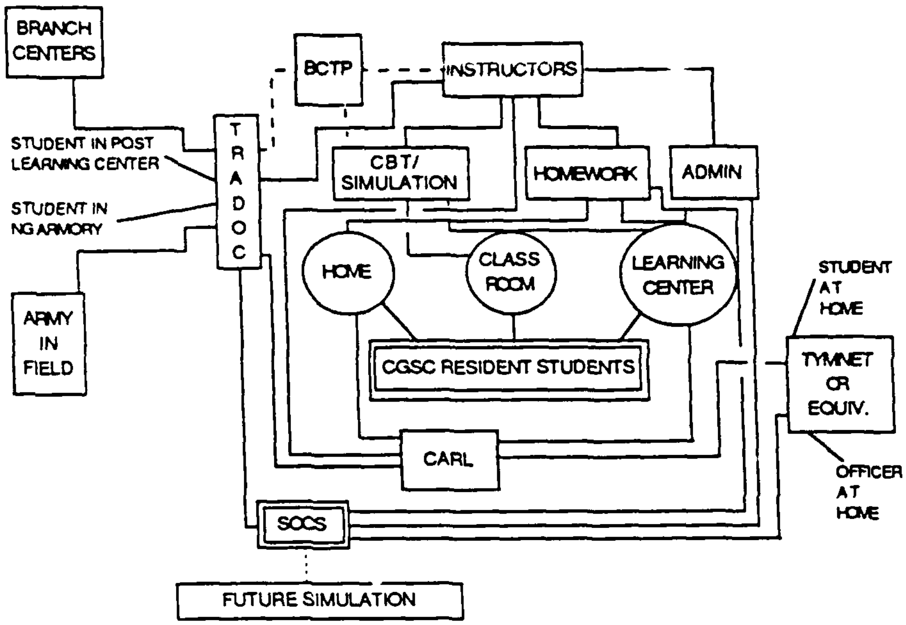

Fig. 1. Notional network for CGSC.

At present, the College has rudimentary plans for implementing networks in the existing and planned facilities. Therefore, the development of a plan for networking that meets the functional requirements of the College must be clearly and carefully considered. Implementation of these plans will occur over a period of years. Initially, the network should support electronic mail between faculty inside the College and other service schools outside Fort Leavenworth and between faculty inside the College and people in other Fort Leavenworth activities. Further, the network must support access to CARL (Combined Arms Research Library), providing remote access by both faculty and students to the electronic card catalog and, eventually, to abstracts and documents.

The network E-mail concept must provide faculty-student interchanges through the "homework" box shown. This box provides for the option of testing of both resident and nonresident students and for transmitting term papers and other assignments as required for any subcourse at CGSC. The resident student links include access from learning centers and quarters as well as from classrooms. Students should have modems available that allow access from quarters. The classroom links should be implemented in the longer term and must be expandable to meet future needs of the College.

A positive image of the College from the outside must be deliberately nurtured. The network elements that concern SOCS (School of Corresponding Studies) students, other service schools, and the officer corps at large make this view possible. Using established Army networks and commercial links, such as Tymnet, can significantly improve the quality of instruction delivered to students in SOCS and the interaction of the officer corps with the College. Doctrine development would certainly benefit.

Achievement of such a complete and complex network capability must be time-phased. Initially, the network system would provide student administrative support, access to the faculty by SOCS students, SOCS resident student asynchronous conferencing, and SOCS student access to the resources of CARL and/or other libraries. The presentation of instruction through this network would be longer term and requires further study. However, the posting of changes to instructional material could be a near-term reality and would require that the distribution of study materials to SOCS students be in electronic form, such as compact disc read-only-memory technology. This electronic publishing technology is available today.

SOCS has about 33,000 students enrolled; and with the possibility that the reserve components will require CAS^3 instruction, SOCS could expand to 45,000 or more students. Thus, SOCS has the greatest potential influence in the development of the officer corps of the "Total Army." This potential suggests that SOCS automation improvements be given high priority in the College's overall plan.

The project team believes the only higher ACL priority is to provide computers for the support of faculty and staff. This support will affect all resident and nonresident instruction as well as doctrine development. When the faculty computer network is complete, SOCS will be in a position to extend some of the advantages of resident instruction to nonresident students through the off post network. The electronic linking of SOCS to the rest of the Army will provide the mechanism to enhance the outside-in view of the College and make the College the electronic university of tactical and operational doctrine.

A description of the individual ACL elements applicable to the College follows. In each discussion, a narrative of the element and its College-specific applications is presented. Where possible, a discussion of the learning methodology that the element and its applications support is included. For the purpose of clarity and at the end of each element discussion, the project team includes a brief summary of the potential for the application, its risk, its estimated costs, and the action that the project team recommends to be taken for the element.

The Administration Element

Administration as an element of the ACL is primarily concerned with increasing the efficiency of the way the College's missions are administratively supported. The primary missions are to develop future combat leaders and to develop and promulgate appropriate Army doctrine. Administering these missions requires performing record keeping, word processing, database management, course registration, and preparation and presentation of instructional and doctrinal material. As these functions are implemented on computers throughout the College, an environment that encourages the users to experiment with alternate ways of using computers in the instruction and doctrine development areas should evolve. This environment will improve the quality of mission performance in the College.

Many quality hardware configurations and software applications for administration are commercially available. Therefore, the hardware and software selection, acquisition processes, and the training of users become the most significant expenses in implementing the administrative use of computers at the College.

The potential applications within the College administration are numerous. These applications include the development and production of lesson materials and training aids; doctrine development to include research, data and information collection, and documentation (such as writing FMs); expanding access of the officer corps to the College; and generally easing administrative management burdens. When this administrative workload is eased, faculty will have more time to concentrate on course content. Higher quality instruction and doctrine development will probably result. Together, these applications will improve both content and productivity in the College administration area.

Several issues must be considered in the implementation of computerized administration. First, the hardware configurations and collections of software to be used for each functional area or office must be identified and then standardized. This process involves examining the functions and organizational structure of the College to define the hardware and software requirements. A small number of standard hardware configurations will be needed, and a greater number of software tools will be needed. It is important that standard interoperable configurations of both hardware and software be identified so that College users will be able to communicate and collaborate on-line with others both inside and outside of the College. Implied in this task is the development of a standard interface tool that specifies how the software is presented to the user and how the user controls the software. This interface must allow for system growth. The window approach developed by XEROX, marketed by Microsoft, and seen as the strength of Apple's Macintosh meets these needs for the user friendly human-computer interface.

The second issue is to provide to the faculty and staff the standard personal computers with the appropriate collection of software programs. Providing these systems also involves the training of personnel for their effective use. Implied here also is instilling in the faculty and staff the confidence that computers can and will improve their personal productivity. The experience of the project team is that if people believe that these tools are going to be effective, then there is a higher probability of success.

The third issue to be handled is the use and availability of computers for students. It is not reasonable to provide each student with a personal computer. However, each student must have access to a computer and its software tools. Civilian universities provide learning centers that make computers and their software available. The College must continue to provide for such centers in its future building and remodeling plans. While this approach decreases the burden of providing each student with a computer, it creates the additional cost of providing and operating the facilities. Because the facilities must be available during nonduty hours, operating costs can be significant. Because this facility could also be used as classrooms for computer training in the College, the expense of learning center implementation can be reduced.

As in the case for the faculty and staff, a standard configuration of hardware and software tools for students is required. The equipment and tools should be available for student purchase. Further, a variety of mutually compatible systems from a basic model up through the full size, luxury model must be available to meet the needs of the individual student budget. The College book store could make this hardware and software available to students, faculty, and staff. This approach was successfully implemented at Drexel University.

Administration

Potential: The systematic introduction of computers into office support, developing instructional and doctrinal material, publishing training aids, and networking the faculty, staff, and students will increase efficiency in all areas of the College. It will also facilitate communication within the College and with the Total Army. The universal availability of computers to faculty, staff, and students at CGSC will also eventually facilitate the widespread use of computers in the field and potentially create a more effective combat force.

Risk: Minimal risk is involved in the administrative use of computers at the College. Hardware and software for most administrative applications are commercially and competitively available. Only a universal interface linking the different applications has not been developed. The sole risk seen is in the selection process for the standard configurations of hardware and software described. A problem exists here because so many choices are commercially available yet not necessarily mutually compatible.

Costs: The project team is using the following five categories for cost estimation:

- Faculty and Staff. The project team estimates that the cost for each staff and faculty configuration would be approximately $3,500, not including training expenses. Annual maintenance costs cannot be determined until system specifications have been defined, but they are estimated at 10 percent of the initial hardware investment cost per year.

- Students. There is no need for students to be issued sets of hardware and software; rather they must have access to these tools. The project team estimates that the number of systems available should be about 30 percent of the maximum number of students resident at any one time. The cost for each setup should be about $3,500, and maintenance costs are estimated at 10 percent per year.

- Networking. The preceding estimates do not include networking costs, which can only be estimated after the system specifications are completed.

- CARL. The cost of converting CARL information (for example, card catalogs and abstracts) into computer-usable form and the cost of associated equipment cannot be estimated until system specifications are defined.

- SOCS. Estimates for the cost of providing the faculty and staff computers are given above. The costs associated with networking SOCS with the Total Army cannot be made until system specifications for the SOCS system are defined.

Action: The implementation of the administrative use of computers throughout the College should be started <u>immediately</u>! This implementation will be a prerequisite to the design and implementation of the other ACL areas.

Testing

The testing element of ACL is the use of computers to measure retention of previously learned KSA and usually involves objective tests, such as multiple choice, true/false, and matching. Testing is seen in the literature as part of the larger computer-managed instruction (CMI) process (Kearsley, 1984). The project team sees the following advantages for computerizing testing at the College. First, an increase in efficiency in grading is possible. Computerized testing of students provides for immediate results for individuals or groups. These results can be readily analyzed on-line by the monitor.

A second and related advantage is increased efficiency in understanding the results of testing through the automatic collation and assessment of test results for statistical purposes. The test analysis programs can be standardized to examine test results for common errors and to use that information to evaluate the test or the learning strategy applied to that subject matter. Better use of instructors' time would result.

The third advantage is the increase in learning efficiency that the use of situational testing could bring to the classroom if situational testing were used. Situational testing is the evaluation of a person's skills when presented a case to solve in other than written form and is still an objective test administered on the computer in such a way that the student provides answers to specific situational questions in an interactive manner. Tests could be designed using a videodisc, for example, that would create a problem that the student must resolve. Scoring and feedback in real time would result. These programs can provide a learning prescription that would assist the student in the learning process.

Applications of testing in the College include the following. A few of the CGSOC core curriculum subcourses have formal testing identified in their POI, accounting for 2.4 percent of the hours of the core curriculum. Testing could easily be implemented in these subcourses. Other CGSOC core curriculum subcourses could incorporate situational testing to improve the learning of students and provide immediate feedback to students on how they are progressing. The P118 and P118L subcourses offer opportunities for situational testing, and the quality of learning of the more objective material would probably improve. Entrance examinations for CGSOC and CAS^3 students are examples of opportunities to efficiently and rapidly test large numbers of students.

Testing

Potential: The greatest potential uses at the College are for improved testing procedures in the SOCS and for entrance validation of skills in CAS^3 and CGSOC. For example, a personalized course of instruction could be prescribed following the testing program. Such a learning prescription could target the specific areas in which a student needs further study. The necessary number of workstations to support testing will not be available in the CGSOC until the General Instruction Building (GIB) is built and renovation of Bell Hall is completed. As far as situational testing is concerned, the long term may provide opportunities for integrating SIT with this testing to greatly improve the effectiveness of instruction. Another potential use of the testing ACL is for collection of survey data among nonresident officers. This testing can be done using the same tools developed for computerized testing.

Risk: Risk is divided into the following topics:

- Entrance testing. There is little risk here. Entrance testing can be done using CMI packages, which have been proved highly effective (Baker, 1981). Providing such testing, however, must wait until the College has the computer workstations and facilities to effect testing for large numbers of students. Selection of off-the-shelf programs for testing is low risk.

- SOCS. There is low risk associated with computer testing of nonresident students because the same software used for resident instruction can be used here. There is no operational network in SOCS or the College to support nonresident testing. Thus, implementation must be deferred until that capability exists.

- Situational testing. Moderate risk in the design and implementation of situational testing is probable. Only further study of the specific subcourse subject material and its application in the instructional strategy of the subcourse can determine the most promising situational testing applications.

Costs: For conventional computer testing, such as entrance testing for CAS^3 and CGSOC, minimal costs are anticipated. These applications can be contracted, or the capability to develop them in-house could be pursued. The most significant costs incurred are to implement the administrative use of computers throughout the College and to purchase the networking capability for SOCS.

Action: Very little action should be taken before the SOCS networks and student workstations are in place at the College. During implementation of the high-tech classrooms and networks, computer testing can be developed.

Computer-Assisted Instruction (CAI)

CAI is the use of computer courseware to teach recently introduced KSA needed for basic task elements, where courseware is defined to be a special subset of software through which instruction can be accomplished on a standalone basis. When examined in relation to Bloom's Taxonomy, CAI most often aligns with the lower order cognitive levels. However, some highly sophisticated applications have been developed. The Combat Unit Leader Trainer (CULT) developed by Los Alamos for the Armor School at Fort Knox is an example of a sophisticated computer tutor that focuses on the higher order cognitive skills. CULT was developed to provide realistic tactics problem solving, including feedback to aid the student in arriving at the "school solution." Among the remaining elements of ACL, CAI is the most mature with numerous commercial applications available for use in the academic domain. The literature contains numerous references comparing the effectiveness of CAI with conventional instruction (Kulik, Kulik, and Cohen, 1980).

Cost of Development

In discussing CAI, it is useful to discuss costs in detail. This discussion is presented first because much of the technology to develop CAI courseware already exists in the commercial and academic realms, and cost is a primary consideration in implementing CAI. Costs can be reasonably well quantified, and discussions of costs provide a basis for evaluating potential usefulness. The typical basic unit for evaluating costs in CAI is one hour of delivered student instruction on the computer.

Figure 2 illustrates the wide variation in the number of hours required to develop one hour of CAI. In Fig. 2, pedagogy refers to the instructional method or format that is to be used to create the CAI application, and author experience refers to the level of familiarity that the lesson developer has with the authoring system being used.

Pedagogy	Author Experience*	
	Low	High
Existing	8-63	6-39
New	165-610	27-180

Fig. 2. Effects of experience and pedagogy on CAI (Avner,1979).

*Production rate (hours of development/hours of courseware) is determined by author experience and the nature of the CAI.

The costs of labor for the personnel that develop the CAI software varies from about $20 per hour up to $90 per hour. The capital costs for specialized equipment needed for CAI software development are not trivial. For example, the use of recent advances in educational technology, such as CD ROM, videodisc, and digital audio are instructively powerful but expensive.

For example, the cost of production of a single videodisc may add from $30,000 to $100,000 one time cost to the development effort. Of course, when this equipment is used many times, the cost per videodisc will be much lower. The video technology, however, provides for a much more realistic training environment than has ever before been feasible. Once developed, the videodisc cannot be readily changed, but the accompanying courseware often does change. Considering the possible impact of doctrine changes on course content is an important consideration when contemplating development of CAI software. Interactive videodisc is an option for CAI that is cost effective for educational applications requiring visual realism.

To indicate what CAI costs might be for CAI software development, consider the following example. Suppose that CAI software for 1 hour of instruction in a 16-person class was being considered. Our example will be for a moderate level application that assumes 200 hours to develop, and the average cost of labor is $50 per hour. Assume that the CAI software is developed for videodisc and that this hour of CAI software must support 20 percent of a $30,000 videodisc capital investment. This development would cost $16,000.

Now, assume that this CAI software was to be used for the 1,000 students in CGSOC. The cost per student taught would then be $16. For comparison purposes, consider the costs incurred if the same material were to be presented by an instructor to the 16-person group. Assume five hours of preparation time for the class and $53 per hour (based on an officer's annual cost of $100,000). One then calculates a cost of $318 for the instructor's time. If one divides this sum by 16 students, she/he gets a cost per student of between $19 and $20.

Suppose that the subcourse does not change content during the following year. The live instructor cost would be constant for the following year at the same $19-$20 per student. In the case of the computer CAI software, the cost per student would halve to $8. The quality of the student-computer interaction would be controlled and constant from year to year but that of the instructor would not be.

As indicated in the sample calculations above, important considerations must be taken into account when deciding whether CAI should be implemented. Discussions of these considerations follow:

- CAI appears to be more successful in teaching skills at the lower levels of Bloom's Taxonomy. The cost involved in developing CAI courseware for teaching lower cognitive level KSA is usually much lower than that for teaching higher cognitive level KSA. Cost is lower because of the simpler instructional strategy used for the lower cognitive levels. (See the discussion of instructional strategies below). The teaching of facts and procedures and remedial instruction for incoming students are examples of where CAI could be developed profitably.

- The development costs of CAI depend upon the authoring environment, experience of the designer and programmer, the instructional strategy chosen, and the structure of the subject area. For example, development costs for drill and practice exercise developed with an authoring system are considerably less than those for a game developed with a programming language. Opportunities for CAI development for subcourses where the content is stable should be considered before developing CAI for more volatile subject areas.

- CAI is especially attractive for subcourses that service large numbers of students. The per student cost varies inversely with the number of students being taught; and yet, the degree of individual learning remains high, making large student enrollment subcourses more lucrative than subcourses with small enrollments.

- The hardware configuration that is used to develop the CAI application is often more complex and more expensive than the classroom delivery system. The CAI delivery system is, in turn, often more complex and requires more capability than that needed for administration applications. For example, for CAI courseware, videodisc, CD ROM, digital audio, and graphic overlays on video are often considered. Hardware to develop the CAI application also requires much greater memory capacity than the classroom delivery system. Both development and delivery hardware configurations must be considered when planning for CAI. We estimate that the cost of a top-of-the-line CAI delivery system is about $12K. However, CAI delivery can be and often is done for much less on an ordinary PC.

- Often, synergistic relationships develop among the aforementioned factors. For example, if subcourse content does not change from year to year, obviously, more students can be taught for a longer period of time with a single CAI development. Therefore, per student costs would be driven down because of more than one factor.

Authoring Systems

CAI programming can now be accomplished with software tools called authoring systems. These tools prompt the author, who is a designer, teacher, or subject matter expert, regarding what he/she wants displayed on the screen--sequence, answer judging, and branching. More than 200 such systems are now on the market from which to select. The design of the CAI lesson is still the most complex part of CAI development, but such tools make the programming feasible for institutions without a staff of programmers.

Instructional Strategies

CAI is only as successful as its design. Central to the design of a CAI software package is its instructional strategy, the pedagogical approach used in helping the student achieve the learning objectives. The literature contains several taxonomies for instructional strategies. The project team recognizes distinct instructional strategies (Alessi and Trollip, 1983):

Tests
Tutorial
Drill and Practice
Games
Simulations

Although the names of several of these strategies are identical to ACL, the taxonomies are complementary. Specifically, any of these strategies can be used within the CAI and ITS ACL.

The particular instructional strategy used depends upon the following factors:

- The expected behavioral change as a result of instruction. For example, if the verb is "to recognize," a drill and practice exercise with multiple choice questions would be acceptable. However, if the verb is "to demonstrate," a simulation strategy would be necessary; and if the verb is "to show skill at using," a gaming strategy might be appropriate. One would not use a tutorial strategy where new information is presented and then tested if a person needed to discover a student's ability to synthesize and apply a great deal of information.

- Other types of instruction currently available in the subject area influence the strategy chosen. For example, classroom instruction of facts may exist, but there may be no realistic opportunities for application of those facts. CAI could provide game or simulation strategies to complement classroom instruction.

- Cost and time constraints affect the selection of an instructional strategy. If a product must be produced quickly and on a very small budget, the drill and practice or testing strategies should be seriously considered. With the modern authoring systems, tutorial CAI can also be produced quickly. The expense for original games and simulations is higher because of the extensive design and programming work required.

Therefore, the objective in taking an instructional strategies approach to CAI development is to maximize learning for the desired target skills. So often in education, we have taught students to recall and recognize and subsequently tested their ability to evaluate or synthesize. Then, we cannot understand why scores are so low! The instructional strategies approach adds complexity to the design phase but has a high payoff for student learning.

Conversion of instructional materials from the classroom directly into the computer is rarely successful. If such a conversion were possible, CAI development costs would be consistently lower because of differences in on-line versus classroom instructional strategies. In live classroom instruction, the instructor is able to adapt in a way computer technologies currently cannot. The potential exists for such adaptation, however, through intelligent tutoring systems research.

CAI, MAPP, and COTES

Many of the subcourses of the College share a need for common computer tools and applications. MAPP (Military Application Program Package), which was developed for CAS^3, and COTES (Combat Orders Training and Evaluation System), used in CGSOC, are examples. Such tools are incidental to CAI but, when considered wisely in developing specific CAI courseware, they will contribute to overall course effectiveness. This consideration reinforces the value of such common tools, produces far more effective learning, and provides the officer corps with tools that can be exported to the field. This situation would improve the outside-in view of the College and improve the computer literacy of those officers who would be exposed to the tools before attending the College.

The Power of CAI in the Classroom

The CAI design must take into account administrative changes that result from introducing computers into the College. When networking of the students and faculty in a classroom is implemented, the capability would probably exist for an instructor to show any student's computer display on a large screen for all to see. CAI development should consider this capability and others and capitalize on them. For example, if a CAI application were generated that involved student development of a project, that result could easily be displayed for student discussion and critique. The effectiveness of staff group instruction may, in turn, be increased.

CAI Hardware Issues

A number of additional hardware-related issues must be discussed in the CAI context. A number of Army activities will influence the availability of development hardware. The Classroom 2 evolution and related introduction of various Army systems, such as Maneuver Control System (MCS) and Army Tactical Command and Control System (ATCCS), will open up possibilities for CAI applications (as well as other ACL) in the College. The development and introduction of EIDS (Electronic Information Delivery System) in the College may have a positive effect on the development of CAI. Approximately 125 EIDS systems are scheduled for delivery to the College, and using EIDS hardware to effect near-term CAI should be considered.

Finally, consideration of CAI for SOCS deserves special attention. At present, as has been noted elsewhere, the SOCS material for CGSOC is largely out of date. This situation can be eliminated for future CAI development by planning for exporting CAI through SOCS for all CAI developed. This planning may place an extra burden on CAI development but is important for improving the quality of the nonresident material. The hardware to export CAI is not available, but this capability must be planned as an integral part of the electronic university concept of SOCS.

CAI Development In House

The College must establish the capability to develop its own CAI course material. The College does not have the necessary skills to develop CAI in house now. If a basic authoring system were selected and personnel assigned to the task of design, a prototype could be produced within a year. The College faculty and staff must be involved in the CAI development process. Only the College knows its subject matter and is aware of the changes that occur in that material. Only the College would probably be responsive to the needs of its academic departments and Schools. It is also important that at least some of the technical (not subject matter) specialists that develop the CAI material be on site for an extended period of time to ensure a smooth transition when staff turnover occurs.

Computer-Assisted Instruction

Potential: For those subject areas that are at the lower cognitive levels, are not volatile in content, and will be taught to large numbers of students, there is great potential for CAI to augment faculty in the classroom. In particular, the COMPS (Combat Skills Comprehension Program) and other remedial subject material appear ideal for CAI. The integration of CAI into the SOCS electronic university also has significant potential for positive influence on the Total Army.

Risk: Low risk is seen for using CAI to teach the subcourses that deal with lower cognitive KSA. This technology is relatively well proven. For teaching KSA at the higher cognitive level, risk increases slightly because there are fewer proven models to follow.

Costs: Design is the most costly part of CAI. Some indication of costs and associated payoffs can be seen from the example above. The costs per hour for CAI development, however, vary widely among applications and are directly related to the instructional strategy selected.

Action: Use an authoring system to develop an exemplary prototype hour of CAI software on a delivery system that demonstrates CAI capability. The subject of the CGSOC elective A035, Faculty Development, would be appropriate for this CAI section because it would be relatively nonvolatile, has large numbers of students each year, and would introduce prospective faculty to the techniques of CAI and skills that they will need as faculty in the College. This development should be under the purview of the Department of Automated Command and Training Systems (DACTS). Furthermore, this project will permit the selection of media for future CAI applications in time to influence the GIB and Bell Hall remodeling needs.

Continued development of MAPP and COTES or some equivalent for use as aids in the classroom should be pursued. As these applications become more sophisticated, ways to integrate them into CAI development courseware should be investigated.

Tables I through V display a detailed listing of the project team's views of potential ACL. These applications should be carefully evaluated by the College faculty for appropriate CAI candidates. A plan for CAI development should be established under the auspices of DACTS.

Simulations for Individual Training (SIT)

What Are SIT?

Simulations for Individual Training are the uses of computers for the analysis and application of previously learned material. These instructional simulations model some aspect of reality with sufficient fidelity to present the student with situations requiring them to apply previously acquired KSA. They can potentially provide the "artificial experience" the College seeks for its students. Development of these simulations is more challenging than that required for any ACL discussed so far. SIT include part-task trainers that, in the CGSOC context, are used to develop an individual staff member's KSA. SIT are intended to be used following the student's acquiring of the facts and procedures in a given knowledge domain. The simulation seeks to require the student to integrate these previously learned KSA into a functional capability.

The Design of SIT

It is important that the SIT that is developed will emulate the real world, including the component of interactions with subordinates and superiors. The design and development of SIT must take into account the characteristics of real world communications and information generation systems, such as MCS. Verisimilitude to what the student will see in the field is important. SIT have three major components: 1) the scenarios, 2) the user interface, and 3) the shell.

The shell consists of the rules governing the delivery of the scenario, the sequence of student action, and the feedback delivered by the interface. This three pronged structure for SIT allows several advantages. Maintenance costs are lower because one can readily update content information without having to touch shell code. The user interface can be modified readily, which is important because interface requirements vary with the target population. Finally, the shell can be used with a variety of different scenarios. These scenarios could all be from one subcourse or be from different subcourses or even different schools of the College. The use of a shell structure increases the usefulness of SIT development and decreases its cost per application.

The Los Alamos project team knows of no SIT developed that meets the needs of CGSC. At Los Alamos, however, a SIT was developed for Fort Knox student armor officer training. This project, called CULT, is funded by ARI and uses an instructional model called "computer-tutor." (See Andrews and Trainor, 1987.) This computer-tutor assumed student knowledge of tactics and challenged the platoon leader to specify fires, formations, and techniques of movement for various offensive and defensive scenarios. This SIT has undergone preliminary testing and a multitude of reviews and has received favorable feedback. Its success is not only attributable to the realism afforded to scenarios through videodisc and digital audio but also to tutorial feedback. When a student's performance is not optimal, the system provides several levels of feedback to aid him in reasoning to the correct answer. This model for SIT could be adapted for use in subject matters of the College. Research is needed to define the specifications of SIT for the College and to move toward their development. As can be seen in Table I, each School has a need for SIT.

SIT and BCTP

The issue of Battle Command Training Program (BCTP) must be discussed regarding SIT. When fully linked to CGSC, BCTP may be useful as a learning vehicle for at least some of the needs that SIT should satisfy. The suitability of BCTP for providing the representation of consequences of a staff officer's actions, the goal of SIT, is yet to be determined. Other uncertainties related to BCTP include the design of the human-computer interface.

Regarding the issue of demand, it seems doubtful that a significant number of students in the CGSOC could simultaneously use the BCTP system without seriously overloading the computing capabilities of the computers planned in the BCTP system. This issue is a serious one because to accomplish the goals of SIT, many individuals must be using the unique simulations that are responding to each student's needs. The BCTP environment supports many players on a commonly used scenario.

Simulations for Individual Training

Potential: SIT has high potential for the teaching of higher cognitive level skills involving the application and analysis of facts and procedures already learned. Unfortunately, no SIT exist that can meet the needs of the College. Los Alamos does, however, have a model that the College could follow in building SIT. Specifications for SIT applications need to be defined as a first step. When SIT are fully developed, they will be useful in supporting several teaching methods but will be particularly adaptable to supporting staff group instruction.

Risk: High risk is seen in starting on an immediate program for the development of the College's ideal SIT. As indicated above, the issues and requirements for SIT in the College must be better defined. The use of prototypes to test out various areas of SIT would ameliorate this high risk. In any event, SIT will take some years to be fully realized in the way that the College would like.

Costs: No estimates can be given at this time because the costs involved in realizing a fully functional SIT are dependent upon the particular application, the model used, and the available resources. Development costs will be greater than for CAI.

Action: The College and its Schools must define their classroom requirements for the use of SIT. This study forms the base line for defining SIT and other applications for the College. The College should expand this base line into a plan for development and design of SIT throughout the College.

Intelligent Tutoring Systems (ITS)

What Are ITS?

Intelligent tutoring systems (Sleeman and Hendley, 1972) are computer-based systems that emulate the learning environment between a student and a human tutor (Roberts and Park, 1983; O'Shea et al., 1984). They employ artificial intelligence (AI) techniques to represent domain knowledge, employ a specified instructional strategy, use inference techniques to assess the student's grasp of the material, and build a model of student behavior to individualize feedback. The greatest potential of ITS is in their ability to detect student misconceptions (Brown and Burton, 1978; Goldstein, 1982; Burton, 1982) and attempt to correct them. They can operate on noisy or incomplete data (Sleeman and Hendley, 1972) and "decide" when to intervene and what advice to give.

ITS Components

ITS have four major components: 1) an expertise module, 2) a student knowledge model, 3) a tutorial advisor, and 4) a communication system. The expertise module contains the domain knowledge that the student is learning. The student knowledge model is a database of student performance and a categorization of student errors. The student's knowledge may be modeled as a subset of an expert's knowledge or alternatively as a set of rules consistently used by the student, whether or not they lead to the correct results (Brown and Burton, 1978).

The tutorial advisor is a model of the knowledge for selecting and presenting material to the student. Its actions are dependent upon feedback received from the student knowledge model. The tutorial advisor contains knowledge about teaching, about selecting material appropriate to the student's perceived learning level, and about when to intervene and what to tell the student in a tutorial session. The tutorial advisor implements the instructional strategy imposed by the ITS designer.

The instructional strategy is the teaching approach adopted by an instructor, typically coaching, games, simulation, Socratic dialog, a diagnostic approach, or some combination of these methods. The communication module is the set of functions that enables the expertise module, student knowledge module, and tutorial advisor to interact with the student. It is the part of the system that drives the actions of other modules in response to student input. The communications system encompasses the human-computer interface of the ITS.

The State of the ITS Field

The first ITS was produced in 1970 (Carbonnel, 1970), and yet the field is still in its infancy. The greatest research challenges facing the field include 1) development of a robust, flexible, natural language parser that does not exceed machine memory capacity, 2) perfection of knowledge engineering technology to facilitate creation of the expertise module, and 3) acquisition of more knowledge regarding optimal tutorial approaches for the construction of the tutorial advice module. In spite of these unsolved research areas, a great deal of attention is being focused on ITS because of their great potential (Kearsley, 1987; Wenger, 1987). Work is in progress in many institutions to produce prototype ITS, which are not optimal but can function prior to the solution of the unsolved research areas. These prototype ITS will not only aid in selecting those research areas but will also serve as models for other institutions that are initiating ITS development efforts.

ITS Examples

The opportunity to use an ITS is rare because of their nonproduction status. It is therefore useful to describe briefly the functioning of three ITS systems: PROUST, SOPHIE, and GUIDON.

PROUST is a misconception identifier, which was developed at Yale University (Johnson and Soloway, 1984). It provides students who are learning the Pascal programming language with automatic debugging. The student writes a Pascal program and attempts to compile it.

PROUST is then called up to examine the program and provide feedback on errors to the student. PROUST not only finds all the bugs but also describes why a bug occurred and suggests how it can be corrected. No dialogue occurs per se, yet the student emerges with personalized tutoring advice to use in correcting specific misconceptions.

SOPHIE is an electronic troubleshooting tutor that provides a reactive learning environment. The problem solving centers around a laboratory model of a circuit. The student can propose and test hypotheses relative to the circuit, have the hypotheses configured, and receive advice.

GUIDON is a tutor based upon cases (Clancey, 1983). The student is given a medical case to diagnose, asking questions to gather important data and propose hypotheses. The tutorial module intervenes to provide help or advice when the student's actions are not correct.

ITS and the College

As this technology evolves and becomes better understood and more functional, there are numerous possible applications for the College. The Los Alamos project team feels that the most interesting application is in the teaching of command and control. Defining the knowledge domain in the enormously complex world of command and control will be a serious challenge to the College. Additionally, when implemented at the College, ITS may provide an impetus for more robust training of command and control throughout the Army. Because of the enormity of developing ITS, these promises must wait for the future.

Intelligent Tutoring Systems

Potential: Very high potential for ITS exists, particularly in complex areas such as command and control. The technology is in its infancy and exists only in laboratory programs. This potential will be realized only in the long term.

Risk: Very high. The greatest challenge here is defining the selected subject area through knowledge engineering techniques, which is essential prior to implementation of any AI system.

Costs: Based on what is known about expert systems and knowledge engineering techniques, the costs are very high. Hopefully, as the technology matures and becomes common in the science and education communities, costs may decrease significantly.

Action: Do not pursue ITS as a learning technology at this time.

Gaming

What is a Learning Game?

In gaming, concepts are applied and practiced through a computer game. Because games are not usually concerned with the detailed results in the situation portrayed, they model the relevant subject at lower fidelity than that of a simulation (Crawford, 1986). However, the entire spectrum of pertinent detail is presented to the student, allowing the user to understand and manipulate the big picture without worrying about the precision in the results. The exercise, manipulation, and practice of concepts are the goals of gaming. Gaming requires the student to exercise the relevant concepts against a real or virtual opponent.

Games for the CGSC

Games can be used by an individual or by a small group of students. This aspect makes gaming attractive for SAMS because the essence of SAMS is to develop a personal philosophy of the tactical and operational art in an elite group of officers. Gaming could be used by individual students to develop and test their detailed understanding of the art of war, arriving at supportable conclusions.

One possible subject area for a game is the operational and tactical level battlefield doctrine with which SAMS is concerned. The game could provide variable resolution of the battlefield from an individual fire unit through battalion and division to corps and joint and combined forces. Individual officers could use it for developing their personal philosophies of the art and conduct of war. The same game could be used in SAMS-wide exercises that would provide the "artificial experience" needed for the students to test their views in a dynamic situation with their peers.

Because the fidelity of gaming is not usually high, gaming can often be run on computers that are modest in capacity compared to those needed to run simulations for collective training. Conceptually, games can be run on a personal computer, and they require small amounts of input from the user. As an example, consider a conceptual G3 game emphasizing tactics. The other staff functions as well as the opposing forces would be simulated by the personal computer. If this game were run as a two sided game, then the opposing forces could easily be played by another student.

Gaming has great potential for development of higher level cognitive skills in the tactics and operational art subcourses in the students of CGSOC and SAMS. It could easily be exported through SOCS and used to close the quality gap between resident and nonresident instruction. Such a game would directly support the staff group instruction teaching strategy of the College, allowing the faculty to concentrate on the content and quality of instruction in resident courses.

SIT Versus Gaming

Gaming and SIT can complement each other. Gaming deals with the broader issues of the situation, and SIT deal with the detailed account of what happened. Both levels of detail are appropriate. For example, consider the use of both a G3 SIT and a G3 game in the CGSOC course. The G3 SIT would deal with the details of procedures and special actions required of a G3, while the G3 game would deal with the broader concepts of the tactical operation and the relation of the G3 to the rest of the staff in the tactical environment being played.

Gaming in Teaching Control

The opportunity of gaming to contribute to the teaching of the control portion of command and control is probably significant. As discussed in the Task B report, FM 101-5 does not clearly represent the KSA required of the staff officer in the area of control. Yet, these KSA are critical for officers to be effective in any tactical situation. Conventional instructional methods are awkward when teaching control because in any realistic control environment, the situation is rapidly changing.

Because gaming is not overly concerned with detailed representation of all aspects of the battlefield, it has the potential to allow practicing the control portion of command and control in the classroom environment. SIT and SCT are too focused on the details of the tactical situation to contribute to quality instruction of control. The project team believes that the instruction of control shows the greatest potential for the use of gaming at CGSC.

The Current State of Gaming

The most glaring negative aspect of gaming that would be relevant to the College is that no suitable game has been developed. However, games can be built up over time to display a higher level of performance so that they can grow to meet the needs of the user. Games can be developed in a relatively short period of time and at a cost relatively low compared to simulations, so the financial risks are much lower than with large simulations.

To illustrate this point, consider the Balance of Power (Crawford, 1986) game referenced earlier. Balance of Power is a commercially available game that runs on a PC or equivalent. The player can choose to play either the United States or the Soviet Union side. The goal of the game is to accumulate a world prestige score that is higher than that of the opponent without causing a world ending nuclear holocaust.The opponent can be either another player or the software of the game. The players take turns determining the state of the world and establishing changes in the world by actions, such as supporting revolutions, sending military aid, and lodging diplomatic protests. Each turn evokes a response in the other player that is not obviously predictable. The presence of rules having results that are not easily forecast challenges the player to become involved in the game and to stretch his/her mind, which is the essential ingredient of a successful game. Chris Crawford took about one year to develop the game. Considering the remarkable ability of this game to develop a view of world politics in the player, a relatively small development cost was paid. This example shows that high-quality games can be developed on submillion dollar budgets.

Gaming

Potential: Very high potential exists for gaming to teach control in situations that are reasonably realistic. Gaming can be used to evaluate the consequences of one's actions in tactical situations.

Risk: Moderate risk exists because tactical games of the type needed have not been developed. However, this risk is ameliorated by the fact that complex games have been developed for recreational uses.

Costs: Relatively low costs are expected for researching the development of the games necessary to significantly improve the learning of CGSC students. If these research approaches prove sound, further development costs should be moderate.

Action: Research into the development of games should be pursued. If results of this research warrant, pursue vigorous development of games that would be useful for teaching control and for meeting the needs of SAMS in developing its students' views of the art of war.

Simulations for Collective Training (SCT)

Collective training, in the Army sense, is the training of groups of people together as a team that will function jointly in accomplishing its mission. SCT involve the use of computers to develop the team KSA needed to accomplish a mission through the use of a simulation. The simulation is used to present evolving situations that demand that team skills be applied. Fidelity to the real world is as high as can be achieved in the simulation environment, making SCT complex and influencing their cost.

Historically, command post exercises (CPX) and field training exercises are the vehicles for training units in their war fighting missions. These exercises have enormous overhead expense associated with their controllers. As a computerized CPX develops, the overhead remains. For example, this situation can be seen in BCTP where more people are required to make the simulation run than can be trained at one time. This overhead expense is typical of SCT.

The College is primarily concerned with individual training. BCTP and other SCT can be used to teach individual KSA needed by staff officers and have great potential. At intervals in the curricula, there are course wide exercises that are used to pull the concepts learned in the course together so that students can practice the individual KSA. These exercises provide the students experience in the total human staff context. A single tool can, therefore, be used for individual and collective training. BCTP may or may not evolve into low-overhead SCT that meet these needs.

Simulations for Collective Training

Potential: High potential because SCT can be used as reduced overhead tools to train students in KSA that relate to functioning as staff officers during combat. If the mission of CGSC broadens to include collective training, SCT will be required.

Risk: High risk because no SCT to date have been developed that will provide sufficiently high fidelity to the situation being modeled at overhead levels that are comfortable. However, once SCT of sufficient detail and low overhead are developed, modifying them for other applications should be low risk.

Costs: High cost is associated with SCT development and in the operation of SCT. The fidelity is high, so large, complex programs demanding high-capacity computers are required to run the simulations.

Action: Because of the high costs for development of SCT, no recommended development program is suggested. The BCTP program should be closely monitored. Then, if it evolves into a low-overhead SCT, integrate it fully into the College. Consideration should be given in this regard to using BCTP in the facilities being developed at Fort Leavenworth.

High-Tech Classroom

The preceding discussion has centered on the individual ACL. The ACL are only worthwhile if there are organizational and physical structures to facilitate their use. The high-tech classroom is one physical structure that can help to achieve this end. The project team envisions a prototype classroom, which contains the latest developments in instructional technology. This classroom includes the use of computers and other technical aids to instruction and serves as a laboratory for experimentation with these technologies. The faculty and staff, along with the students, can explore some of the limits of these technologies. Faculty could try out various educational technologies and methodologies and become familiar with them.

The classroom might have a computer workstation for each two students and a controlling workstation for the instructor. The student workstation would connect to two separate but interconnected computers, allowing for data access and manipulation, emulation of MCS, videographics capability, and networking to the appropriate CGSC and Army activities.

The student-computer interface would be user friendly in the sense that few instructions would be necessary; it would be easy to use and easy to learn regardless of previous computer experience. This interface would be accomplished through use of menus, icons, natural language, graphics, voice, and other techniques. The instructor would have the ability to display examples or sample problems for the student to dynamically solve and then discuss. Available to the students and instructor would be the appropriate administrative, test, CAI, SIT, ITS, gaming, and SCT systems. As appropriate, these systems could be used and improved upon by the students and instructors. Additional applications would be developed and documented for future College implementation. Army activities and programs, such as ATCCS, BCTP, EIDS, and others, would be tested in the high-tech classroom first and expanded or rejected as necessary for meeting the needs of the College and the Army.

Details of a high-tech classroom design remain to be established. However, the project team sees this classroom as central to the implementation of many of the applications that would be incorporated into the College; and eventually, all classrooms in the College would contain some instructional technologies. The high-tech classroom would be the vehicle for bringing CGSC into the age of computer education.

Data

The ACL taxonomy that was developed by the project team is applied to the curricula of CGSC in Tables I through V. A table is presented for the CAS^3 Phase II resident course, for the core curriculum for CGSOC, for the electives for CGSOC, for the SAMS course, and for percentage totals of ACL usage for courses of CGSC. Each curriculum is broken down into its subcourses as organized by the latest POI that the project team had. The following information is recorded in the columns of the tables.

Column Heading	Information in the Column
HOURS #	The number of hours in the subcourse.
NA	The percentage of the subcourse to which no application of computers was assigned.
ADM	A "Y" indicates that administrative use of computers in the subcourse is appropriate. All subcourses have a "Y" entry.
TEST	The percentage of the subcourse to which computers could be used in the testing function.
CAI	The percentage of the subcourse to which computer-assisted instruction techniques could be applied.
SIT	The percentage of the subcourse to which simulations for individual training could be applied.
ITS	The percentage of the subcourse to which intelligent tutoring systems could be applied.
GAM	The percentage of the subcourse to which gaming could be applied.
SCT	The percentage of the subcourse to which simulations for collective training could be applied.
COMMENTS	The number of the subcourse and the subcourse name are usually repeated here. In addition, the specific applications that the project team judged could be used are stated briefly with other comments as appropriate.

At the bottom of each of the tables, a summation line and a percent line are included. The summations line shows the number of hours that we judge the ACL to be in effect for the entire course. The percent line shows the percentage of the course to which the ACL could be applied.

The final table shows two summations. One of these summations includes total hours and percentages for each of the ACL elements for all four courses examined here, and the other summation shows the totals without the CGSOC electives included.

TABLE I. ACL Usage for CAS* Phase II Course

SUBCOURSE NUMBER	HOURS #	NA	ADM	TEST	CAI	SIT	ITS	GAM	SCT	COMMENTS
CAS3										
F121-STAFF TECHNIQUES										
F121-1 PRBLMSOLV	5	50	Y	0	50	0	0	0	0	F121-1-PROBLEM SOLVING AND PREPARING A STAFF STUDY CAN BE TAUGHT BY CAI.
F121-2 MILWRITNG	10	50	Y	0	50	0	0	0	0	F121-2-MILITARY WRITING FORMATS AND EXERCISES ARE SUITED FOR CAI.
F121-3 QUANTSKIL	18	50	Y	0	50	0	0	0	0	F121-3-THESE QUANTITATIVE SKILLS CAN BE TAUGHT USING CAI.
F121-4 TIME MGMT	2	50	Y	0	50	0	0	0	0	F121-4-CAI CAN REPLACE THE LESSON ON TIME MANAGEMENT.
F121-5 MIL BRIEF	8	85	Y	0	15	0	0	0	0	F121-5-CAI CAN REPLACE SOME OF THE LESSON ON MILITARY BRIEFING.
F121-6 MTG MGMT	3	70	Y	0	30	0	0	0	0	F121-6-CAI IS SUITABLE FOR TEACHING PARTS OF MEETING MANAGEMENT.
F323-TRAINING MANAGEMENT										
F323-1 TRNG FUND	4	40	Y	0	60	0	0	0	0	F323-1-TRAINING FUNDAMENTALS CAN BE TAUGHT USING CAI.
F323-2 BNTRNGPRO	14	50	Y	0	25	25	0	0	0	F323-2-CAI CAN BE USED TO DEVELOP BASIC KNOWLEDGE. SIMULATIONS CAN BE USED TO AID STUDENTS IN SOLVING A TRAINING MGMT PROBLEM.
F323-3 SOTRNGMGM	4	50	Y	0	0	25	25	0	0	F323-3-EITHER SIMULATIONS OR ITS CAN BE USED TO FACILITATE THIS EXERCISE.
F323-4 BN EXPLNG	6	50	Y	0	0	0	25	0	25	F323-4-SEE COMMENTS IN F323-3 ABOVE.
F323-5 TRNG >BN	8	50	Y	0	30	0	0	0	20	F323-5-CAI CAN BE USED FOR THE FACTUAL MATERIAL, AND SIMULATION CAN BE USED FOR THE EXERCISE.
F424-BUDGET										
F424-1 BNRESMGMT	9	40	Y	0	10	25	0	25	0	F424-1-THE EXERCISE CAN BE RUN AS AN INDIVIDUAL SIMULATION.
F424-2 INSTRSMGM	28	50	Y	0	25	25	0	0	0	F424-2-FACTUAL INFORMATION CAN BE TAUGHT BY CAI, AND A SIMULATION CAN BE USED TO TEACH ANALYSIS.
F525-MOBILIZATION										
F525-1 PREMOBPRE	6	75	Y	0	25	0	0	0	0	F525-1-CAI CAN BE USED TO TEACH FACTS OF MOBILIZATION.
F525-2 MOBPLANNG	20	50	Y	0	0	25	0	0	25	F525-2-SIMULATION CAN BE USED FOR DEVELOPMENT MOBILIZATION PLAN.
F525-3 OPREDIMPR	7.5	50	Y	0	0	25	0	0	25	F525-3-SIMULATIONS CAN BE USED TO DRIVE THE EXERCISE BUT NOT TO PREPARE THE BRIEFINGS.
F626-PREPARATION FOR COMBAT OPERATIONS										
F626-1 INTRODUCT	1	50	Y	0	50	0	0	0	0	F626-1-CAI IS SUITED FOR INTRODUCING FACTS.
F626-2 DECMISANA	2	50	Y	0	50	0	0	0	0	F626-2-CAI IS SUITED FOR TEACHING ANALYSIS PROCEDURES.
F626-3 CA BRIEF	7	100	Y	0	0	0	0	0	0	F626-3-BRIEFINGS MUST BE PREPARED AND PRESENTED BY THE STUDENT.
F626-4 INTL EST	17	40	Y	0	30	30	0	0	0	F626-4-CAI CAN BE USED TO TEACH FACTUAL INFORMATION, AND SIMULATIONS CAN BE USED TO DRIVE EXERCISES.
F626-5 STAFFRIDE	5	100	Y	0	0	0	0	0	0	F625-5-STAFF RIDE. ACL NA
F626-6 CVMLOPEST	1	50	Y	0	50	0	0	0	0	F626-6-FACTUAL MATERIAL CAN BE TAUGHT USING CAI.
F626-7 LOGREADNG	5	50	Y	0	25	25	0	0	0	F626-7-FACTS CAN BE TAUGHT BY CAI, AND SIMULATIONS CAN BE USED TO DRIVE THE EXERCISE.
F626-8 LOGBRIEF	6	100	Y	0	0	0	0	0	0	
F626-9 LOG EST	6	50	Y	0	50	0	0	0	0	F626-9-CAI CAN BE USED TO AID STUDENTS IN PREPARING THE LOG ESTIMATE.
F626-10 PER EST	6	50	Y	0	50	0	0	0	0	F626-10-CAI CAN BE USED TO AID STUDENTS IN PREPARING PERSONNEL ESTIMATE.
F626-11 OP EST	9	50	Y	0	50	0	0	0	0	F626-11-PREPARING THE OPERATIONS ESTIMATE CAN BE TAUGHT USING CAI.
F626-12 DIVOPLAN	5	50	Y	0	25	25	0	0	0	F626-12-CAI CAN BE USED TO PREPARE THE OPLAN.
F626-13 SS&CSSOV	5	50	Y	0	25	25	0	0	0	F626-13-CAI CAN BE USED TO PREPARE THE SERVICE SUPPORT ANNEX AND THE CSS OVERLAY.
F626-14 OFFENSE	6	50	Y	0	25	25	0	0	0	F626-14-CAI CAN BE USED TO PREPARE THE DIVISION COUNTERATTACK PLAN AND TO TEACH OFFENSIVE CONSIDERATIONS OF AIRLAND BATTLE.
F626-15 CORPSLOG	4	50	Y	0	30	20	0	0	0	F626-15-CAI/SIM CAN BE USED TO LEARN PROCEDURES OF COSCOM ORGANIZATION.
F626-16 MOV PLAN	4	70	Y	0	20	10	0	0	0	F626-16-CAI/SIM CAN BE USED TO PREPARE A ROAD MOVEMENT PLAN.
F626-17 DEPLYMNT	6	60	Y	0	20	20	0	0	0	F626-17-CAI/SIM CAN BE USED TO AID IN PREPARATION OF THE OVERSEAS DEPLOYMENT PLAN.
F727-EUROPEAN EXERCISE										
F727-1 EUR EX	49	44	Y	0	0	56	0	0	0	F727-SIMULATION CAN BE USED AS THE EXERCISE DRIVER.
SUMMATION (/100)	296.5	19.24		0	9.2	3.86	0.5	0.25	44.	
PERCENT		53.2		0.0	21.4	20.5	0.8	0.8	3.4	

TABLE 11. ACL Usage for CGSC Core Curriculum

SUBCOURSE NUMBER	HOURS #	AA	ADM	TEST	CAI	SIT	ITS	GAM	SCI	COMMENTS
COMPS	37	25	Y	10	65	0	0	0	0	COMPS-CAI IS IDEALLY USEFUL HERE
MGMT-DSRO										
P211	4	40	Y	0	60	0	0	0	0	P211-COMPUTER OPERATIONS. CAI IS IDEALLY USEFUL HERE
P212	34	24	Y	11	65	0	0	0	0	P212-RESOURCE PLANNING AND ALLOCATION. CAI USEFUL IN TEACHING ALL MATH RELATIONSHIPS.
P251	19	26	Y	0	50	12	12	0	0	P251-FORCE INTEGRATION- TRAINING. CAI USEFUL FOR MOST, BUT INDIVIDUAL SIMULATION AND ITS USEFUL TO DEVELOP AND ANALYZE DIVISION TRAINING PLAN.
TACTICS-CTAC, ET AL.										
P310	172	30	Y	3	10	10	7	30	10	P310-COMBAT OPERATIONS- CAI USEFUL FOR THE TEACHING OF FACTUAL MATERIAL. THE USE OF SIMULATIONS AND GAMES SHOULD BE EXPLOITED TO PROVIDE ARTIFICIAL EXPERIENCE IN THE PLANNING AND EXECUTION OF TACTICAL OPERATIONS AT DIVISION AND CORPS LEVELS.
SDE321	24	20	Y	0	0	0	0	0	80	SDE321-MIDDLE EAST EXERCISE. USE OF COLLECTIVE SIMULATION TO TEACH ARTIFICIAL EXPERIENCE IN THE CONTEXT OF THE MIDDLE EAST IS REQUIRED.
CSS-DSRO ET AL.										
P318(L)	24	30	Y	0	20	10	10	20	10	P318(L)-COMBAT OPERATIONS SUSTAINMENT. THE SAME COMMENTS AS IN P310 APPLY BECAUSE THIS SUBCOURSE IS INTEGRAL TO P310.
P137(L)	24	30	Y	5	15	10	10	20	10	P137-JOINT OPERATIONS-SUSTAINMENT. CAI IS USEFUL IN TEACHING FACTUAL MATERIAL. USE OF SIMULATIONS AND ITS COULD REINFORCE THE UNDERSTANDING AND PRACTICE OF CSS IN PREPARATION FOR THE EXERCISE.
SDE414(L)	21	20	Y	0	0	0	0	0	80	SDE414(L)-KOREAN STAFF BATTLE EXERCISE. GAMING IS SUITABLE FOR PROVIDING ARTIFICIAL EXPERIENCE REQUIRED BY THIS EXERCISE.
NATIONAL SECURITY POLICY-DJCO										
P510	4	30	Y	0	70	0	0	0	0	P510-ORGANIZATION OF US ARMED FORCES. LOW COGNITIVE LEVEL TRAINING EASILY TAUGHT USING CAI.
P511	80	40	Y	0	30	20	10	0	0	P511-JOINT AND COMBINED OPERATIONS. CAI, SIMULATIONS, AND ITS ALL CAN BE USED TO DEVELOP THE FACTUAL MATERIAL AND UNDERSTANDING OF THE STRATEGIC AND OPERATIONAL ENVIRONMENT NEEDED TO APPLY THE CGSC STRATEGIC ANALYSIS MODEL FOR PLANNING THESE OPERATIONS.
P521	4	40	Y	0	15	10	25	10	0	P521-US CENTRAL COMMAND & EUROPEAN COMMAND OPERATIONS. ANALYSIS OF US POLICY AND DEVELOPMENT OF PLANNING CONSIDERATIONS CAN BE SUPPORTED BY INDIVIDUAL SIMULATIONS, ITS, AND GAMING.
P531	4	40	Y	0	15	10	25	10	0	P531-US SOUTHERN COMMAND/US FORCES CARIBBEAN OPERATIONS. ANALYSIS OF US POLICY AND DEVELOPMENT OF PLANNING CONSIDERATIONS CAN BE SUPPORTED BY INDIVIDUAL SIMULATIONS, ITS, AND GAMING.
P551	4	50	Y	0	30	20	0	0	0	P551-US ARMY IN SPACE. CAI CAN BE USED TO TEACH FACTUAL MATERIAL. ITS AND SIMULATIONS CAN BE USED TO EXAMINE THE ORGANIZATIONS, MISSIONS AND ROLE OF SDI.
P552	18	52	Y	3	25	20	0	0	0	P552-LOW-INTENSITY CONFLICT. CAI CAN PROVIDE INSTRUCTION IN THE FACTUAL INFORMATION NEEDED AND SIMULATIONS CAN ALLOW STUDENTS TO DEVELOP AND ANALYZE LIC PLANS.
P157	70	40	Y	0	30	10	10	0	10	P157-OPERATIONAL WARFIGHTING. SIMULATIONS CAN BE USED TO DEVELOP INTEGRATED PLANS NEEDED TO CONDUCT THE THEATER WAR FOR THREE SUBORDINATE THEATERS OF OPERATION.
MILITARY HISTORY-CSI										
P611	1	40	Y	0	60	0	0	0	0	P611-AMERICAN HERITAGE SUITABLE FOR CAI.
P613	29	48	Y	0	35	0	17	0	0	P613-20TH CENTURY WAR; THE AMERICAN EXPERIENCE. BACKGROUND AND HISTORICAL DEVELOPMENT FOR ORAL AND WRITTEN PRESENTATIONS COULD BE TAUGHT BY CAI. ITS COULD AID IN ANALYSIS OF THE ISSUES.
P651	25	100	Y	0	0	0	0	0	0	P651-BATTLE ANALYSIS. ORAL BRIEFING BASED ON LIBRARY RESEARCH.
PROFESSION OF ARMS-CAL										
P911	12	30	Y	0	70	0	0	0	0	P911-EFFECTIVE MILITARY WRITING. CAI IDEALLY SUITED FOR THIS INSTRUCTION.
P912	8	40	Y	0	60	0	0	0	0	P912-STAFF DYNAMICS. FACTUAL MATERIAL CAN BE PRESENTED EASILY USING CAI.
P913	14	50	Y	0	50	0	0	0	0	P913-LEADERSHIP. FACTUAL MATERIAL CAN BE TAUGHT USING CAI.
P951	12	40	Y	0	60	0	0	0	0	P951-MILITARY LAW. FACTUAL MATERIAL OF MILITARY LAW CAN BE TAUGHT USING CAI.
SUMMATION (/100)	473	1.82		0.38	3.35	1.32	1.26	0.9	2	
PERCENT		35.8		2.4	20.5	7.9	6.3	9.4	9.7	

TABLE III. ACL Usage for the CGSOC Electives

SUBCOURSE NUMBER	HOURS #	NA	ADM	TEST	CAI	SIT	ITS	GAM	SCT	COMMENTS
CGSOC-ELECTIVES										
A011	30	100	Y	0	0	0	0	0	0	A011-RESEARCH METHODOLOGY-I. MMAS THESIS OUTLINE AND CH 1 DRAFT.
A021	30	100	Y	0	0	0	0	0	0	A021-RESEARCH METHODOLOGY-II. MMAS ORAL PRESENTATION AND THESIS DRAFTS.
A031	30	100	Y	0	0	0	0	0	0	A031-RESEARCH METHODOLOGY-III. MMAS THESIS COMPLETED AND ORAL DEFENSE.
A032	15	75	Y	0	25	0	0	0	0	A032-MEDIA AND COMMANDER. FACTUAL MATERIAL CAN BE TAUGHT USING CAI.
A035	60	75	Y	0	25	0	0	0	0	A035-FACULTY DEVELOPMENT. CAI USEFUL TO TEACH FACTS RELATED TO INSTRUCTION AT CGSC.
A036	30	25	Y	0	75	0	0	0	0	A036-RESERVE COMPONENTS. CAI USEFUL TO TEACH FACTS RELATED TO INSTRUCTION AT CGSC.
A051	30	25	Y	0	50	0	0	25	0	A051-HISTORIC USE OF SEAPOWER. CAI USEFUL FOR TEACHING FACTUAL MATERIAL. GAMES CAN BE USED TO FACILITATE ARTIFICIAL EXPERIENCE.
A052	30	40	Y	0	60	0	0	0	0	A052-AMPHIBIOUS OPERATIONS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A053	30	40	Y	0	60	0	0	0	0	A053-AIR FORCE STRATEGIC STUDIES. CAI USEFUL IN TEACHING FACTUAL MATERIAL.
A054	15	100	Y	0	0	0	0	0	0	A054-AIR FORCE RESEARCH PROJECT. ORAL AND WRITTEN REPORTS.
A055	30	25	Y	0	25	0	0	50	0	A055-PLANNING AND EMPLOYMENT OF TACTICAL AIRPOWER. GAMES USEFUL FOR DEVELOPING THE CONCEPT OF OPERATION FOR A COUNTERAIR CAMPAIGN. CAI USEFUL FOR TEACHING FACTUAL MATERIAL.
A056	30	40	Y	0	60	0	0	0	0	A056-HISTORY OF AIR WARFARE. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A222	30	35	Y	0	20	25	0	20	0	A222-ADVANCED OPERATIONS RESEARCH. CAI, SIMULATIONS, AND GAMES CAN ALL BE USED TO TEACH AND DEMONSTRATE THE OR PRINCIPALS INVOLVED.
A231	30	50	Y	0	50	0	0	0	0	A231-FORCE DEVELOPMENT. CAI CAN BE USED TO TEACH THE FACTUAL MATERIAL.
A232	30	25	Y	0	25	25	0	25	0	A232 MILITARY OPERATIONS RESEARCH. COURSE EXAMINES OR TO APPLY IT TO NUMEROUS PROBLEMS. CAI CAN TEACH FACTUAL MATERIAL; SIMULATIONS AND GAMES CAN BE USED TO PROVIDE INSIGHT INTO THE APPLICATIONS AND TO PROVIDE ARTIFICIAL EXPERIENCE.
A233	30	50	Y	0	50	0	0	0	0	A233-ADVANCED FINANCIAL MANAGEMENT. CAI USEFUL IN TEACHING HOW THE ARMY FINANCIAL MANAGEMENT SYSTEM WORKS.
A250	30	50	Y	0	50	0	0	0	0	A250-TRAINING IN UNITS. A SERIES OF TOPICS THAT CAN BE PRESENTED USING CAI AND LECTURE/DISCUSSION TO COMPLEMENT EACH OTHER.
A251	30	25	Y	0	50	25	0	0	0	A251-MILITARY DECISIONMAKING USE CAI TO TEACH FACTUAL MATERIAL AND SIMULATIONS TO RUN THE APPLICATIONS.
A252	30	25	Y	0	50	0	25	0	0	A252-FUNDAMENTALS OF INFORMATION PROCESSING. USE CAI TO TEACH HOW TO USE A COMPUTER AND PROGRAM IN BASIC. BASIC PROGRAM TUTORS PROBABLY EXIST IN THE COMMERCIAL SECTOR.
A254	30	40	Y	0	40	0	20	0	0	A254-INFORMATION SYSTEMS DESIGN SEMINAR. USE CAI TO TEACH STUDENTS PRINCIPLES OF DESIGN FOR INFORMATION SYSTEMS.
A255	30	40	Y	0	60	0	0	0	0	A255-TACTICAL UNIT FINANCIAL MANAGEMENT. USE CAI TO TEACH THE PRINCIPLES OF FINANCIAL MANAGEMENT AT TACTICAL UNITS.
A256	30	40	Y	0	60	0	0	0	0	A256-QUANTITATIVE METHODS IN PERSONNEL AND LOGISTICS. CAI IS USEFUL IN TEACHING THESE QUANTITATIVE METHODS.
A258	30	40	Y	0	60	0	0	0	0	A258-RESOURCE MANAGEMENT AT OPERATING LEVELS. CAI IS SUITED FOR TEACHING THESE SKILLS.
A290	30	40	Y	0	60	0	0	0	0	A290-ADVANCED PROGRAMMING CONCEPTS (PASCAL). CAI CAN BE USED TO TEACH PASCAL PROGRAMMING. COMMERCIAL TUTORS MAY EXIST.
A291	30	50	Y	0	25	0	0	25	0	A291-DYNAMICS FOR ORGANIZATIONAL EXCELLENCE. CAI CAN BE USED FOR TEACHING THE FACTUAL MATERIAL, AND GAMES CAN BE USED FOR DEVELOPING ADVANCED SKILLS.
A321	30	25	Y	0	0	0	0	75	0	A321-JOINT MIDDLE EAST OPERATIONS PLANNING AND EXECUTION. A WAR GAME IS IDEALLY SUITED FOR THIS EXERCISE.
A331	30	25	Y	0	0	0	0	75	0	A331-COMMAND AND CONTROL IN THE CENTRAL REGION. COMPUTER GAMES OFFER AN OBVIOUS WAY TO DEVELOP ARTIFICIAL EXPERIENCE FOR THE STUDENT.
A334	30	25	Y	0	0	75	0	0	0	A334-APPLIED BRIGADE PLANNER. SIMULATIONS COULD BE USED TO DEVELOP AND ANALYZE COURSES OF ACTION.
A351	30	100	Y	0	0	0	0	0	0	A351-LIGHT INFANTRY DIVISION OPERATIONS. COURSE DEVOTED TO ORAL PRESENTATIONS AND DISCUSSIONS ABOUT NEW TECHNOLOGY FOR LIGHT DIVISIONS.
A352	30	25	Y	0	0	0	0	75	0	A352-SOVIET OPERATIONAL ART. GAMES ARE IDEALLY SUITED TO TEACHING US STUDENTS HOW SOVIET OFFICERS THINK.
A353	30	25	Y	0	50	0	0	25	0	A353-RIVER CROSSING OPERATIONS. CAI AND GAMES, COMBINED COULD TEACH THE FACTUAL MATERIAL AND ARTIFICIAL EXPERIENCE NEEDED IN RIVER CROSSING OPS

TABLE III. ACL Usage for the CGSOC Electives (continued)

SUBCOURSE NUMBER	HOURS #	NA	ADM	TEST	CAI	SIT	ITS	GAM	SCI	COMMENTS
CGSOC-ELECTIVES										
A354	30	25	Y	0	50	0	0	25	0	A354-NUCLEAR WEAPONS EMPLOYMENT. LOTS OF FACTUAL MATERIAL NOW TAUGHT USING SELF-PACED CAN BE REPLACED BY CAI. GAMING CAN REPLACE THE EXERCISE.
A355	30	40	Y	0	35	0	0	25	0	A355-G2/CEWI UNIT OPERATIONS. CAI USEFUL FOR FACTUAL MATERIALS. GAMES USEFUL FOR ENCOURAGING STUDENTS TO DO TERRAIN, ECCM, ETC. ANALYSIS.
A357	30	40	Y	0	60	0	0	0	0	A357-INTELLIGENCE FOR COMMANDERS. MOSTLY FACTUAL MATERIAL RELATED TO INTEL AND COMMO INTERFACES IN THE MILITARY; THEREFORE, CAI.
A391	90	75	Y	0	0	0	0	25	0	A391-OPERATIONAL LEVEL OF WAR. GAMES ARE IDEAL IN DEVELOPING ABILITY TO DESIGN AND CONDUCT SUCCESSFUL OPERATIONS.
A395	30	25	Y	0	50	0	0	25	0	A395-TACTICS AND OPERATIONS RESEARCH. CAI AND GAMES TOGETHER COULD TEACH FACT AND DEVELOP ARTIFICIAL EXPERIENCE NEEDED FOR DIVISION OPERATIONS.
A396	60	50	Y	0	0	50	0	0	0	A396-APPLIED TACTICAL OPERATIONS. SIMULATIONS CAN BE USED TO DEVELOP AND EVALUATE TACTICAL PLANS AND ORDERS.
A425	30	40	Y	0	25	0	0	35	0	A425-CIVIL-MILITARY OPERATIONS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL, AND GAMES CAN BE USED TO DEVELOP ARTIFICIAL EXPERIENCE NEEDED TO APPLY THIS KNOWLEDGE.
A433	30	100	Y	0	0	0	0	0	0	A433-ADVANCED LOGISTICS MANAGEMENT. SEMINAR FORMAT OF EXPERTS DOES NOT LEND ITSELF TO USING COMPUTERS.
A437	70	40	Y	0	60	0	0	0	0	A437-PERSONNEL MANAGEMENT AND ADMINISTRATION. MOST OF THE COURSE IS DEVOTED TO FACTUAL MATERIAL AND IDEALLY SUITED TO CAI.
A451	30	40	Y	0	60	0	0	0	0	A451-LOGISTICS FOR COMMANDERS. CAI CAN EASILY BE USED TO TEACH FACTUAL MATERIAL.
A452	30	40	Y	0	60	0	0	0	0	A452-THE MATERIAL ACQUISITION PROCESS. CAI SUITED FOR TEACHING FACTUAL MATERIAL.
A456	30	40	Y	0	35	0	0	25	0	A456-DEPLOYMENT: A COMMANDER'S PERSPECTIVE. CAI CAN BE USED FOR TEACHING FACTUAL MATERIAL AND GAMES USED FOR DEVELOPING ARTIFICIAL EXPERIENCE.
A458	30	35	Y	0	40	0	0	25	0	A458-PERSONNEL SUPPORT OF COMBAT OPERATIONS. CAI CAN BE USED FOR TEACHING FACTUAL MATERIAL, AND GAMES CAN BE USED FOR DEVELOPING ARTIFICIAL EXPERIENCE NEEDED FOR PERSONNEL SUPPORT.
A459	30	35	Y	0	40	0	0	25	0	A459-LOGISTICS SUPPORT OF THE BATTLE. CAI CAN BE USED FOR TEACHING FACTUAL MATERIAL AND GAMES CAN BE USED FOR DEVELOPING ARTIFICIAL EXPERIENCE NEEDED FOR PERSONNEL SUPPORT.
A520	30	100	Y	0	0	0	0	0	0	A520-RESEARCH IN LOW INTENSITY CONFLICT.
A522	30	50	Y	0	50	0	0	0	0	A522-NATIONAL SECURITY POLICY FORMULATION. THE FACTUAL MATERIAL CAN BE PRESENTED USING CAI.
A524	30	60	Y	0	40	0	0	0	0	A524-INTERNAL WAR AND REVOLUTION. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A527	30	50	Y	0	0	0	0	50	0	A527-JOINT FORCES PLANNING I (CONCEPT DEVELOPMENT). GAMES CAN BE USED TO DEVELOP ARTIFICIAL EXPERIENCE NEEDED BE JOINT PLANNERS.
A530	30	40	Y	0	60	0	0	0	0	A530-INTERNAL DEFENSE AND DEVELOPMENT. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A533	30	100	Y	0	0	0	0	0	0	A533-SPECIAL OPERATIONS FORCES. GUEST SPEAKERS AND RESEARCH.
A534	30	40	Y	0	60	0	0	0	0	A534-KOREAN ASSESSMENT. CAI CAN BE USED FOR TEACHING FACTUAL MATERIAL.
A535	30	100	Y	0	0	0	0	0	0	A535-RESEARCH IN US ARMY SPACE APPLICATIONS.
A536	30	60	Y	0	40	0	0	0	0	A536-CRISIS ACTION SYSTEM. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A537	30	30	Y	0	20	0	0	50	0	A537-JOINT FORCES PLANNING II. GAMES CAN BE USED TO DEVELOP ARTIFICIAL EXPERIENCE NEEDED BY JOINT PLANNERS.
A538	30	50	Y	0	50	0	0	0	0	A538-COMMAND, CONTROL, AND COMMUNICATIONS IN JOINT AND COMBINED OPERATIONS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A539	30	50	Y	0	50	0	0	0	0	A539-ALLIED OPERATIONS IN EUROPE. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A550	30	100	Y	0	0	0	0	0	0	A550-WRITING FOR PUBLICATION (STRATEGY).
A551	30	100	Y	0	0	0	0	0	0	A551-REGIONAL SECURITY PERSPECTIVES.
A552	30	50	Y	0	50	0	0	0	0	A552-JOINT COMMAND STAFFS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A553	30	75	Y	0	25	0	0	0	0	A553-AREA STUDIES-PEOPLES REPUBLIC OF CHINA. CAI CAN BE USED TO PRESENT FACTUAL MATERIAL.
A554	30	40	Y	0	60	0	0	0	0	A554-STRATEGIES OF THE SOVIET UNION. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A555	30	50	Y	0	50	0	0	0	0	A555-CURRENT STRATEGIC CONCEPTS. CAI CAN BE USED TO TEACH FACTS.

TABLE III. ACL Usage for the CGSOC Electives (continued)

SUBCOURSE NUMBER	HOURS #	NA	ADM	TEST	CAI	SIT	ITS	GAM	SCI	COMMENTS
CGSOC-ELECTIVES										
A556	30	40	Y	0	60	0	0	0	0	A556-GEOGRAPHY AND GEOPOLITICS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A557	30	40	Y	0	60	0	0	0	0	A557-STRATEGIES OF ARMS CONTROL. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A558	30	40	Y	0	60	0	0	0	0	A558-MILITARY POWER IN THE SOVIET UNION. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A559	30	50	Y	0	50	0	0	0	0	A559-AREA STUDY-MIDDLE EAST. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A590	30	50	Y	0	50	0	0	0	0	A590-AREA STUDY-AFRICA. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A591	30	50	Y	0	50	0	0	0	0	A591-AREA STUDY-LATIN AMERICA. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A593	30	100	Y	0	0	0	0	0	0	A593-US INTEREST IN THE PACIFIC. STUDIES OF SELECTED PACIFIC COUNTRIES.
A594	30	100	Y	0	0	0	0	0		A594-RESEARCH IN OPERATIONAL WARFARE.
A595	30	50	Y	0	50	0	0	0	0	A595-NATO PLANNING AND OPERATIONS AT ECHELONS ABOVE CORPS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A596	30	100	Y	0	0	0	0	0	0	A596-SPACE OPERATIONS. NO DESCRIPTION AVAILABLE.
A597	30	100	Y	0	0	0	0	0	0	A597-RESEARCH IN TERRORISM.
A622	30	100	Y	0	0	0	0	0	0	A622-MORRISON PROFESSORS LECTURE.
A624	30	40	Y	0	60	0	0	0	0	A624-GERMAN MILITARY HISTORY. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A626	30	100	Y	0	0	0	0	0	0	A646-SMALL WARS: CASE STUDIES IN US MILITARY INTERVENTION SINCE 1898.
A627	30	50	Y	0	50	0	0	0	0	A627-THE KOREAN WAR. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A631	30	50	Y	0	50	0	0	0	0	A631-MILITARY HISTORY OF WORLD WAR II. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A633	30	100	Y	0	0	0	0	0	0	A633-MORRISON PROFESSORS RESEARCH ELECTIVE.
A638	30	100	Y	0	0	0	0	0	0	A638-ANALYSIS OF WAR. USES FILMS TO LOOK AT WAR IN 20TH CENTURY.
A639	30	100	Y	0	0	0	0	0	0	A639-ADVANCED HISTORY OF MILITARY INTELLIGENCE. INDEPENDENT STUDENT STUDY.
A651	30	100	Y	0	0	0	0	0	0	A651-MODERN MILITARY THOUGHT. STUDENT SEMINAR PRESENTATIONS.
A652	30	50	Y	0	50	0	0	0	0	A652-HISTORY OF THE WAR IN THE MIDDLE EAST. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A653	30	50	Y	0	50	0	0	0	0	A653-ASIAN MILITARY HISTORY. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A654	30	50	Y	0	50	0	0	0	0	A654-LOGISTICS HISTORY-SUSTAINING COMBAT OPERATIONS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A655	30	100	Y	0	0	0	0	0	0	A655-STAFF RIDE.
A656	30	100	Y	0	0	0	0	0	0	A656-MEN IN BATTLE. COLLOQUIA
A657	30	100	Y	0	0	0	0	0	0	A657-TOPICS IN MILITARY HISTORY; RESEARCH ELECTIVE.
A692	30	50	Y	0	50	0	0	0	0	A692-MODERN COMMANDERS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A694	30	40	Y	0	60	0	0	0	0	A694-SOVIET MILITARY HISTORY. CAI CAN BE USED TO TEACH FACTUAL MATERIAL
A695	30	100	Y	0	0	0	0	0	0	A695-THE AMERICAN EXPERIENCE IN VIETNAM. PBS TV DOCUMENTARY.
A697	30	100	Y	0	0	0	0	0	0	A697-MILITARY CLASSICS SEMINAR.
A698	30	50	Y	0	50	0	0	0	0	A698-MULTINATIONAL OPERATIONS; INTEROPERABILITY. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A937	30	50	Y	0	50	0	0	0	0	A937-MILITARY ADMINISTRATIVE LAW. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A950	30	100	Y	0	0	0	0	0	0	A950-EFFECTIVE SPEAKING.
A951	30	40	Y	0	60	0	0	0	0	A951-EFFECTIVE WRITING. CAI CAN BE USED EFFECTIVELY TO TEACH FACTUAL MATERIAL
A952	30	50	Y	0	50	0	0	0	0	A952-WRITING STRATEGIES. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A953	30	100	Y	0	0	0	0	0	0	A953-LEADERSHIP SEMINAR.
A955	30	40	Y	0	60	0	0	0	0	A955-MILITARY LAW. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
A959	30	50	Y	0	50	0	0	0	0	A959-OPERATIONAL LAW FOR COMMANDERS. CAI CAN BE USED TO TEACH FACTUAL MATERIAL.
SUMMATION (/100)	3120	59.3		0	32.2	2	0.45	7.05	0	
PERCENT		58.8		0.0	31.1	2.4	0.4	7.3	0.0	

TABLE IV. ACL Usage for SAMS Course

SUBCOURSE NUMBER	HOURS #	NA	ADM	TEST	CAI	SIT	ITS	GAM	SCT	COMMENTS
SAMS										
S00101	16	100	Y	0	0	0	0	0	0	S101-INTRODUCTION AND CONCLUSION ARE NOT APPROPRIATE FOR COMPUTERS.
S00102	180	100	Y	0	0	0	0	0	0	S102-FIELD EXERCISES ARE NOT APPROPRIATE FOR COMPUTERS.
S00110	132	40	Y	0	0	30	0	30	0	S110-SIMULATIONS AND GAMING WOULD BE USEFUL IN TEACHING HOW TO THINK ABOUT WAR. IN PARTICULAR, WELL-STRUCTURED GAMING WOULD PROVIDE STUDENTS WITH A FRAMEWORK TO THINK CREATIVELY ABOUT THE ART OF WAR.
S00111	264	30	Y	0	0	35	0	35	0	S111-THOSE SIMULATION & GAMES USED IN S00110 SHOULD BE AVAILABLE TO STUDENTS FOR INDIVIDUAL STUDY AND MANIPULATION.
S00120	20	40	Y	0	0	30	0	30	0	S120-SIMULATION AND GAMES CAN BE USED TO TEACH FACTS AND TO LEARN THEORY OF SMALL UNIT ACTIONS.
S00121	40	50	Y	0	0	25	0	25	0	S121-THOSE SIMS AND GAMES USED IN S00120 SHOULD BE AVAILABLE FOR STUDY.
S00122	8	50	Y	0	0	50	0	0	0	S122-SIMULATIONS OF SOVIET BATTLEFIELD DYNAMICS COULD BE USED TO IMPROVE STUDENTS' UNDERSTANDING.
S00123	16	20	Y	0	0	20	0	60	0	S123-A COMBINATION OF SIMULATION AND GAMING COULD ADD DEPTH TO THE UNDERSTANDING OF COMPANY ENGAGEMENTS.
S00124	32	20	Y	0	0	20	0	60	0	S124-A COMBINATION OF SIMULATION AND GAMING COULD ADD DEPTH TO THE UNDERSTANDING OF COMPANY ENGAGEMENTS.
S00125	4	20	Y	0	0	20	0	60	0	S125-A COMBINATION OF SIMULATION AND GAMING COULD ADD DEPTH TO THE UNDERSTANDING OF COMPANY ENGAGEMENTS.
S00130	28	30	Y	0	0	30	0	40	0	S130-SIMULATIONS AND GAMES CAN BE USED TO PROVIDE AN UNDERSTANDING OF DOCTRINE AND ORGANIZATION OF US AND SOVIET UNITS.
S00131	56	40	Y	0	0	10	0	50	0	S131-SIMS AND GAMES AVAILABLE IN S130 SHOULD BE USED.
S00132	88	20	Y	0	0	0	0	0	80	S132-GAMING CAN BE USED TO IMPROVE STUDENTS' TACTICAL JUDGEMENT AND TO EXECUTE DECISIONS AGAINST A REALISTIC ENEMY.
S00133	96	20	Y	0	0	0	0	0	80	S133-GAMING CAN BE USED TO IMPROVE STUDENTS' TACTICAL JUDGEMENT AND TO EXECUTE DECISIONS AGAINST A REALISTIC ENEMY.
S00140	120	30	Y	0	0	30	0	40	0	S140-SIMULATIONS COULD BE USED TO ASSIST IN PLAYING HISTORICAL BATTLES.
S00141	280	30	Y	0	0	30	0	40	0	S141-SIMULATIONS COULD BE USED TO ASSIST IN PLAYING HISTORICAL BATTLES.
S00150	60	30	Y	0	0	0	0	70	0	S150-GAMING COULD BE USED TO PROVIDE THE STRUCTURE FOR THIS SUBCOURSE.
S00151	120	40	Y	0	0	0	0	60	0	S151-GAMES USED IN S00150 SHOULD BE AVAILABLE TO STUDENTS FOR INDIVIDUAL STUDY.
S00152	80	100	Y	0	0	0	0	0	0	
S00153	56	100	Y	0	0	0	0	0	0	
S00154	64	100	Y	0	0	0	0	0	0	
S00155	40	100	Y	0	0	0	0	0	0	
S00160	68	20	Y	0	0	40	0	40	0	S160-GAMING CAN BE USED TO AID IN AN IN-DEPTH UNDERSTANDING OF LIC.
S00161	136	40	Y	0	0	30	0	30	0	S161-GAMES USED IN S00160 COULD BE USED BY STUDENTS IN THEIR INDEPENDENT STUDY.
S00170	36	20	Y	0	0	40	0	40	0	S170-GAMES COULD AID IN UNDERSTANDING PREPARATIONS FOR WAR.
S00171	72	40	Y	0	0	30	0	30	0	S171-GAMES USED IN S00170 SHOULD BE AVAILABLE TO STUDENTS FOR INDEPENDENT STUDY.
S00180	4	100	Y	0	0	0	0	0	0	S180-COMPREHENSIVE ORAL EXAM.
SUMMATION (/100)	2116	13.3		0	0	4.7	0	7.4	1.6	
PERCENT		45.9		0.0	0.0	18.9	0.0	28.2	7.0	

TABLE V. Percentage Totals of ACL Usage for Courses of CGSC

Course	Hours	NA	Test	CAI	SIT	ITS	GAM	SCT
CAS^3	296.5	157.7	0.0	63.5	60.8	2.4	2.4	9.8
		53.2%	0.0%	21.4%	20.5%	0.8%	0.8%	3.3%
CGSOC (Core)	674	241.3	16.2	192.1	53.2	42.5	63.4	65.4
		35.8%	2.4%	28.5%	7.9%	6.3	9.4%	9.7%
CGSOC (Elec)	3120	1834.6	0.0	970.3	74.9	12.5	227.8	0.0
		58.8%	0.0%	31.1%	2.4%	0.4%	7.3%	0.0%
SAMS	2116	971.2	0.0	0.0	399.9	0.0	596.7	146.0
		45.9%	0.0%	0.0%	18.9%	0.0%	28.2%	6.9%
Total	6206.5	3204.8	16.2	1225.9	588.8	57.3	890.2	221.2
		106.8%	0.5%	40.9%	19.6%	1.9%	29.7%	7.4%

CAS^3	Hours	NA	Test	CAI	SIT	ITS	GAM	SCT
	296.5	157.7	0.0	63.5	60.8	2.4	2.4	9.8
		53.2%	0.0%	21.4%	20.5%	0.8%	0.8%	3.3%
CGSOC (Core)	674	241.3	16.2	192.1	53.2	42.5	63.4	65.4
		35.8%	2.4%	28.5%	7.9%	6.3%	9.4%	9.7%
SAMS	2116	971.2	0.0	0.0	399.9	0.0	596.7	146.0
		45.9%	0.0%	0.0%	18.9%	0.0%	28.3%	6.9%
Total	3086.5	1370.3	16.2	255.5	588.8	44.8	662.4	221.2
		44.4%	0.5%	8.3%	19.6%	1.5%	21.5%	7.2%

RESULTS

Presentation of Project Team Suggestions

The judgments made by the project team regarding the appropriate categories of ACL and the proportion of classroom hours to which each is appropriate are listed by subcourse in the preceding tables. The project team is unable to estimate how long it would take for its suggestions to be fully implemented, primarily because of current uncertainties concerning how suitable courseware will be developed and how long that process will take.

Summary

The project team believes that all CGSC instruction would benefit from applying computers to administrative tasks associated with instruction, primarily by raising the productivity of the staff and faculty. Furthermore, the team endorses the choice of small group instruction as the preferred training strategy at CGSC. It also believes that 55 percent of resident CGSC instruction would be improved by suitable ACL in the classroom. Estimates by the project team of the proportion of course classroom hours that could appropriately use those applications are shown by course and category of application in Table VI. As already noted here, applications from the category of administration, as defined in the taxonomy displayed in the main project report, are universally appropriate in virtually every activity of the College and consequently are not listed. The other categories are symbolized as follows:

0 = No applications other than administrative are suitable.
2 = Testing.
3 = Computer-assisted instruction.
4 = Simulation for individual training.
6 = Gaming.
7 = Simulation for collective training.

TABLE VI. Number of Classroom Hours Using the Indicated Category of ACL and Percentage of Total Course Hours

Course	Total Course Hours	0	2	3	4	5	6	7
CAS^3	296.5	157.7	0.0	63.5	60.8	2.4	2.4	9.8
		53.2%	0.0%	21.4%	20.5%	0.8%	0.8%	3.3%
CGSOC (Core)	674	263.5	16.2	214.3	70.8	42.5	1.3	65.4
		39.1%	2.4%	31.8%	10.5%	6.3%	0.2%	9.7%
SAMS	2116	971.2	0.0	0.0	399.9	0.0	596.7	146.0
		45.9%	0.0%	0.0%	18.9%	0.0%	28.2%	6.9%

The data in Task F established a correlation between the cognitive levels of CGSC learning objectives and those of the KSA needed by graduates of the various schools of the College. This correlation can be seen in the table above in the increasing use of gaming and SCT as the course subject matter concerns itself with higher order command and control problems in the progression from CAS^3 through CGSOC to SAMS. The table also shows the high degree of applicability of CAI for instruction in CAS^3 and CGSOC, of SIT for CAS^3, and gaming for SAMS.

DISCUSSION/INTERPRETATION

The Project Team Ideal Situation

The preceding judgments assume that the appropriate courseware, models, games, and intelligent tutors had all been designed and that their use in the classroom would demonstrate a significant improvement in the effectiveness of instruction compared with previous methods. Thus, they envision a situation that can only be regarded as an ideal toward which CGSC might direct its efforts in coming years.

Prerequisites

Realization of any version of an ideal situation for presenting instruction at CGSC with the aid of computers will have to follow the formulation and implementation of an approved plan for acquisition of a network of suitable types of computers at CGSC, the design and preparation of appropriate courseware for each subcourse with a role planned for computers, and the writing of accompanying programs for the computers.

The establishment of functional requirements demonstrating a need for the enhanced capability that computers could bring to CGSC is the obvious first step in preparing a suitable acquisition plan, which must be made compatible with other plans of the installation and of higher headquarters. The ideal presented in Fig. 1 could serve to identify part of the functional requirements.

The development of software for classroom instruction using computers would be a continuing task whose definition should logically serve to describe the characteristics of the computers sought through the acquisition plan. Clearly, the computers acquired should be capable of accommodating the most complex of the required computer programs, that is, those creating the greatest demand on the capacity of the computers using them. An unavoidable complication of the logic is that until at least a preliminary design of suitable software has been prepared the capacity required of each computer can only be estimated. For flexibility, the computer network should be designed for maximum feasible growth potential.

Selecting Computer Applications

Small group instruction appears to be the most appropriate strategy for imparting the KSA with which CGSC curricula are concerned. This situation may be especially true because functioning as part of an efficient team is a major element in the qualifications of a competent staff officer and teamwork is difficult to teach without the opportunities for practice afforded in small groups. There are obvious exceptions, as when a guest speaker can spend only a limited time at the College, forcing a single presentation or appearances before a few large groups. By and large, however, teaching small groups of students will be more effective than the alternatives and should present few problems when computers are used in the instruction.

Implicit in estimating the capacity required of the computers is some conception of the most demanding kinds of programs they may be required to handle. One aspect of that kind of conception has to do with the kinds of combat simulation models CGSC will adopt for use in the classroom and in the other activities in which it will be engaged, for example, doctrine development and the BCTP. The project team believes that large, exquisitely detailed, deterministic models, such as some that have been developed for use in operations research/systems analysis activities, may be inappropriate for use in CGSC classrooms.

A number of reasons can be advanced for taking this view. First, effective use of this kind of model could only be made by instructors who had been extensively prepared beforehand by becoming intimately familiar both with the model and with the programs and their components representing the model in the computers using them.

Additionally, specific learning objectives might more easily be achieved without elaborate attempts to recreate actual combat situations in a war whose terms might well turn out to be unprecedented. Effort to capture the complex interactions characterizing force on force engagements of whatever nature in a model must often resort to aggregating some predictable kinds of interactions in an approximation reflecting an expectation of the net result of those particular interactions. Inevitably, an element of unreality is thereby introduced that, in fact, may detract from achieving learning objectives, as when the student implicitly accepts the expectation in place of the considerably more complicated and unpredictable outcomes he will face in combat. This situation seems particularly likely in the case of deterministic models that process inputs to produce outcomes that are predetermined by the algorithms built into the process.

In particular, it is the conviction of the project team that many CGSC learning objectives could effectively be reached through the use of games, which can be designed perhaps more easily than more faithful simulations to present the student with the need to appreciate and apply concepts rather than procedures. A place will remain in the classroom and in the field for simulations, both for individual and for collective training. It is not clear, however, that the same simulations would serve in every case for each of these different purposes. Specifically, while each of those teaching contexts needs to portray particular hypothetical situations with which to confront students, it may not be necessary in the classroom that each successive situation be seen to follow from the action chosen in the preceding situation.

Finally, it is evident that realistic force on force combat computer simulations, apart from the difficulty of deciding the criteria on which to base an assessment of their realism, are some years away from development to the point of obviating the current need for large and expensive overhead in the form of human controllers and other support personnel. In the meantime, it may be that less ambitious simulations and games could be developed for achieving specifically identified CGSC learning objectives at much less expense and in a much shorter period of time, permitting their early introduction in CGSC instruction.

In any case, CGSC will have to decide whether tools for developing doctrine and for training staffs from Army organizations in the field will be the same in every case as those used for its part in teaching students the KSA in its schools that they will need to perform as principal staff officers of tactical and operational commands.

CONCLUSIONS

Instructional Strategy

Instructing small groups of students in each classroom appears to be the most effective approach to teaching the material CGSC needs to convey to its graduates. This strategy facilitates the use of networked computers in the classroom to simulate the functioning of a staff with its teamwork and can be adapted to other computer applications.

Computer Opportunities

Opportunities abound for applying appropriate further uses of computers in CGSC classrooms. Those uses could come from each of the categories of ACL defined in this report and listed in the section entitled Analysis of ACL Elements.

Hardware Acquisition

The computers that will be required for ACL at CGSC should constitute a network designed to accommodate the following: the courseware that will have to be developed, the other missions of CGSC in addition to individual training, and the acquisition plans of the installation and higher headquarters.

Courseware Development

The development of courseware for ACL at CGSC should begin as expeditiously as possible after a careful assessment of each subcourse learning objective for the suitability of achieving that objective through ACL from one or more of the categories defined in this report.

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